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August 19, 1926

l Frame for 555 foot
ower of American
rance Union Building,
Columbus, Ohio

Snow Removal on Mountain Pass Roads

Factors Governing Air Inlet Valves

Laying Concrete Sewer on Ocean Floor

Steel Frame Office Building with High Tower

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Extending the Railway's Reach

MOTOR buses are going to be used by the Baltimore & Ohio R.R. in New York City to stretch out the railway service beyond the terminal tracks. Since the war this road has been using the Pennsylvania Station as its New York terminal but that lease has now expired and passengers from New York wishing to use the B. & O. were in prospect of being forced to make their own way to the ferries which would take them to the Jersey City terminal across the Hudson River. This, the railway executives recognized, set up an initial bar to be overcome so they have inaugurated what they call a "motor coach service." By this new scheme prospective passengers on the B. & O. can take motor buses at either of two centrally located stations in the heart of New York or can board these buses along specified routes and be delivered at the railway station in Jersey City, as a part of the service the ticket offers. Motorbus extension of the railway into areas not densely enough populated to warrant rail lines is becoming fairly common. The B. & O. experiment is novel in that it penetrates territory too dense and too valuable to permit further rail extension.

Saturation

AFGHANISTAN has one automobile to each 1,200-000 of population. The United States has 1 to every 6. Which is nearest to automobile saturation point? For the whole world there is 1 automobile to 71 people and for that part of it outside the United States the ratio is 1 to 361. These and the wide varieties for the various countries of the world, detailed as of Jan. 1926, in *Commerce Reports* for July 12, may be taken as an illustration of the possibilities of the expansion of industry and trade in all fields of activity. The saturation point in any field is relative as between countries or regions and changes everywhere as time and the world advances.

Shades of Malthus

THE Malthusian doctrine of population saturation and food exhaustion was again in evidence at the recent meeting of the British Association for the Advancement of Science. It is a more serious question than automobile saturation but subject to much the same influences. Just as there are vast numbers of families still without even one automobile so there are boundless opportunities to increase food production. These include extension of food producing areas, both by going to virgin soils and by returning to those once used but abandoned. Unit rates of food production can be greatly increased by better seeds and cultivation, the use of more and better fertilizers, and the extensions of engineering methods, including more use of mechanical power. Vast areas in the United States and elsewhere still have unnecessarily low unit area crop production, due to causes well known to the federal and state agricultural specialists and to the more progressive farmers. Meat and dairy products could also be vastly increased by well known methods, some of which would contribute incidentally but materially to grain, potato and other crop yields. Moreover, high as some food prices are, price increases could be met, in the United States and some other countries at least, by cutting a bit into the sums spent for luxuries—automobiles and their upkeep for instance. Both here and among the teeming populations of India and China an increased use of power in agricultural and other fields would enlarge both the producing and the consuming possibilities of the people, and, to name only one more possibility, higher food prices would send more men and women back to the farms, bring abandoned farms back into cultivation, improve farming, gardening, dairying and stock raising methods and render all more productive. Altogether, the world need have no fear of automobile or population saturation.

A Prudent Check

A HELPFUL decision has just been rendered by the Attorney General of the United States in a question involving further expenditure of federal money on Western land improvement by irrigation. The decision places a prudent check on such expenditures by showing that the law requires the financial feasibility of each scheme to be proved before starting work. It is quite in line with a similar finding of the Attorney General's office made some months ago, but applying to an earlier appropriation. The new decision adds to this by a legal finding that the most recent appropriations for new reclamation projects are subject to the same control of prudence as previous appropriations even though financial feasibility is not expressly mentioned. The origin of the decision throws a peculiar light on the public spirit of some elected officials. In spite of the unpromising character of the latest reclamation schemes, as discussed recently in these columns, a number of Oregon members of Congress insisted that the money appropriated for these projects at the last session of Congress should be expended, regardless of whether the Secretary of the Interior was satisfied concerning their feasibility or not. The Baker project in Oregon was the specific object of their solicitude. Five sessions of Congress have made or re-made appropriations for constructing this project, but none of them are free from certain safeguards which express the intent of Congress to have the money expended prudently. The Secretary of the Interior has not approved the feasibility of this project, and, it seems, is not yet willing to begin constructing it. It is one of the high-cost projects, and on present outlook is decidedly unlikely to repay the government loan in full as the law re-

quires. Undoubtedly local interests—land owners and others—would profit by the construction of the project, but it is not obvious that the government should undertake the local improvement for this reason. The case is in fact a prominent example of those Western development schemes that are for local profit and should be local undertakings. The Attorney General's finding will encourage close scrutiny of the merits of public expenditure for such improvements.

Snow Drift Excavation

SNOW removal is rarely an excavation problem on eastern highways except in the cities. Here the piling up of gutter windrows as the street center is kept clear results in hard-packed snow banks which offer a real task in excavation. On rural roads in those states of the east which do much snow-removal work, the method of progressive removal which is followed gives little chance for drift accumulation and consolidation. It is these two occurrences which transform snow removal from a task of shifting by plows and sweepers to a task of digging with power shovels and explosives. The big drifts of the mountain-pass roads of the West are the product of all-winter accumulation and consolidation or of slides which mechanically compress the snow to almost the solidity of ice. The conditions are set forth in the articles in this issue on snow removal in Washington and in Colorado. They are worth noting. Snow which weighs up to 40 lb. a cubic foot, in which a post-hole auger is required to bore blast holes and for whose excavation power shovels are not illogical tools, is as much a problem in digging and handling as are many soils for moving which machine excavators are held to be appropriate and economical. The volumes too are comparable with earth-moving operations commonly considered as of magnitude. Two quite different conclusions about power-shovel drift removal appear to have been recorded in Colorado and in Washington but there is complete agreement that the operation is a machine task and one for machines of power and magnitude.

Commercialized Definitions

IT would seem to be a fairly simple matter to define "brick" and "concrete." If a poll were taken of the average run of literate humans there would be practical unanimity as to what these materials are. Certainly, at least, they could tell them when they saw them, which is reasonable proof that there should not be much difficulty in defining them. It takes the experts, however, to quibble over definitions and to find difficulties where difficulties do not exist. So, simple as "brick" and "concrete" might seem to be, the committees of the American Society for Testing Materials are trying their best to make them complicated. Last June some of these committees considered the two terms, as the result of which we have the astounding recommendation of one committee that the word "concrete" should never be used without the use of a qualifying adjective to indicate the binding medium; e.g., portland cement concrete, asphaltic concrete, alumina cement concrete. Note the use of the word "never." It is so conducive to simplicity of expression. At the same time another committee (with a somewhat different preponderance of commercial interest) voted that the word "brick," simple and unadorned, means a burnt clay prism of the accepted size and appearance that even the four-year old knows as a "brick," but that when that prism contains sand-lime, or cement or whatsoever other binder, that binder shall be specifically and regularly denoted. It so happens that this journal agrees with the last named committee and, by the same token, disagrees with the first one, but it cannot become much excited over the matter when it recognizes that the whole squabble reduces itself largely to a rather small-minded struggle for commercial advantage. We know a brick when we see it, and if anyone talks about a brick and doesn't qualify that brick we, and we believe 99.7 per cent of the engineers and builders of this country, are going to assume that it is of clay. We know what concrete is, and if someone talks about concrete, just plain ordinary concrete, we are not going to wonder whether possibly it was mixed with asphalt or tar or glue. We'll know. And we lay no claim to more than average intelligence.

Watching Unemployment

UNEMPLOYMENT fortunately has not been one of the things to worry this country for the past five years. Since the depression of 1921, when so many were out of work that the President felt called upon to call a conference at Washington to discuss the serious situation created, the gradually increasing production and consumption has provided work at good wages to whomsoever would work. But prosperity may not always be with us and when it begins to depart one of the earliest and most obvious indications will be the man and woman out of a job. Indeed to be out of work when money is needed to care for a family is the outstanding misery of hard times. This misery cannot be avoided merely by taking common thought or by any active move when once the unemployment spectre begins to stalk, for by then the damage has been done, the economic causes that bring about depression have already long been in operation and unemployment is only one of the sequels.

But it is becoming more and more believable that there is such a thing as sensible control of economic forces, that there is something wrong with our old belief that prosperity comes and goes at its own sweet will or at least as the result of uncontrollable causes. We can watch production more closely than we used to, we can watch consumption and wages and prices from day to day and from month to month and as time goes on build up a life history, as it were, of world-wide economic movements. And by studying that history we may be able to put our finger on certain tendencies as expressed statistically and say "just here it became evident that we were overproduced, and there the fall off in consumption or excessive jump in wages was a warning that months ahead something was bound to happen." In other words, we are perfecting our statistical technique to a point where it becomes not only a record of the past but a prophet of the future.

So far, however, we have neglected the statistics of employment. Not that we have not plenty of records in isolated industries or in special localities. We have. But nation and industry wide statistics have been meager. Statisticians have recognized this and are setting about to remedy the lack. A committee of the American Statistical Association just recently submitted a report which bids fair to be useful. It advo-

cates a plan which calls for the collection of employment statistics by state labor bureaus, with the United States Department of Labor the co-ordinating center. In addition, the plan commends and urges the extension of the regular collection of employment statistics by federal bureaus having a direct relation to certain industries, such as the Geological Survey for mines and quarries, the Interstate Commerce Commission for railroads, and the Department of Agriculture for farms, and the reporting of all these data to the Federal Bureau of Labor Statistics for prompt publication of national indexes of employment.

With such a statistical survey currently kept to date there would be available another one of the numerous indications of the state of the economic world that are necessary to this modern theory of economic control. Not that any one man or any one agency by a study of the figures of employment would be able to do anything about it, but in time the many men who control industry, government officials, bankers, manufacturers, all who take thought of the future, would be able to trace the tendencies of employment, not only in their own fields but in all business and industry, and be beforehand in taking such action as experience had shown them was necessary to forestall the results that this kind of employment movement foretold.

This may sound Utopian to the hardheaded business man who takes things as they come and plays hunches more than statistics but it is practical enough to interest a great many other hardheaded men. It cannot take the place of sound business principles or of natural economic law. It is not a law, in fact, but the mere scientific observation of law. Such scientific observation has proved fairly efficacious in our adaptation of natural law to the use of man. Why not try it in the realm of economic law?

For the Inspiration of the City Engineer

SOMEWHAT over a year ago *Engineering News-Record* started a study of the engineering work of our small cities, that is those generally speaking of between 10,000 and 50,000 population. Four of the editors traveled well over 10,000 miles in visiting some 60 of these cities and in interviewing there the city engineers, under whatever title they carried on their work. The results of that study have been embodied in the series of articles under the general head of "The Editor Visits the City Engineer."

Every section of the country was visited and every type of organization was described. The result is a co-ordinated survey of a type of engineering activity that is far from standardized, that has received but little attention of late by engineers in general but which in the aggregate makes up a significant part of the engineering impress on the ordinary living conditions of our people. The specific observations of the survey are included in the separate articles of the series, the general observations as then amassed were the subject of a special article in the first issue of this year, but the closing of the series, for no more articles are intended to be published for the present, should not be recorded without the suggestion that the engineer in municipal work should take heed of the lessons that the survey taught.

These lessons are not only the detailed ones to be learned from the specific ways of doing things in our many small cities; there is a larger one and that is the sense of the importance of his job that this record should impress on every city engineer in those towns where to one man is delegated the actual engineering work of the community. Many city engineers have an inferiority complex. They regard their work as pretty much routine, something that is laid down by precedent and carried out with about the same requirement for constructive thinking as the city clerk's office demands. In consequence their own view of their job is accepted by the citizens and by those officials the citizens elect. The fact is that engineering in the small city is, or can be made, original, constructive work with a variety of scope and of interest few engineering jobs attain. The articles we have been able to present prove that the city engineers need to recognize it and to stand up more for their rights and insist more on the contribution they are making to their city's progress.

If a reading of our articles sets up such a reaction in the mind of the engineers of our two or three thousand towns and small cities where engineers are caring for the health, comfort and safety of their people, the survey will have done something it was hoped it would when it was projected, for beside the always desirable informative value that such articles aim for, this particular series had an inspirational intent as well.

Municipal Bond Programs

IN line with the advocacy of capital outlay budgets on p. 166 of our issue of July 29 is the 10-year bond program totaling $60,000,000 proposed for Cincinnati, Ohio, by City Manager Sherrill. The discussion in the city council following the presentation of this program was illuminating. Both it and the succeeding conference of delegates of tax associations in the mayor's office brought to public attention the ever-increasing and never-ending needs of our cities and at the same time emphasized the necessity for planning well ahead.

Six millions a year might look small to some Cincinnatians and be passed by as not demanding their attention but $60,000,000 will set many of them thinking, especially when they see how much or how little—according to their viewpoints—it will do. Some will lose no time in saying that $60,000,000 is altogether too much capifal outlay even for ten years, and will point to this or that expenditure which they think can be cut out or postponed. Others, noting some object dear to their hearts that has been omitted will say either that the $60,000,000 is too little or else propose that some of the items be replaced by one or more that seem to them more urgent. In either case public opinion will be created and expressed.

Department heads, called upon as was done at Cincinnati, have first to canvass needs of their departments for years to come, then arrange the needs in order of urgency. The same thing then has to be done on a large scale, for all departments, by the city manager. The program is then reviewed from quite different viewpoints by the city council, by tax and other associations, and by citizens who do their own thinking.

Contrasted with all this, most of our cities and villages decide on capital outlays one by one, with little attention to the year's total, even, and less thought for the years to come. All honor to the leaders here and there who propose capital budget programs—may the number of cities that follow such leaders increase!

Steel-Frame Office Building with 555½-Ft. Tower

Girder Framing and Novel Wind Bracing Connections in 20-Story Structure at Columbus with 47-Story Tower—Spandrel Girders—Portal Bracing at High Entrance Archways

A 20-STORY building having a 47-story tower and to be used for both office and hotel purposes, with a theater in an annex, is a notable steel frame structure now being built at Columbus, Ohio, as the home office of the American Insurance Union. In the general view, Fig. 1, taken on April 9, the steel work is erected to the 43d floor, the concrete floors are built up to the 18th floor and the exterior walls of terra-cotta are completed in the lower stories, except where open spaces are left for the lofty entrance archways. Adjacent to the building, at the right, is the Deshler Hotel, which has leased several floors as an annex. In the foreground is the Broad St. bridge over the Scioto River.

The American Insurance Union Building, at the corner of Broad and Front Sts., with narrow streets on the other two sides, is L-shaped in plan, with frontages of about 188 ft. on each street and widths of 54 and 75 ft. for the two wings. At the corner is the tower, about 76x79 ft. in plan, with a total height of 555½ ft. from the sidewalk to the top of the decorative finial. In the rectangular space behind the wings is the theater, about 112x135 ft., with its roof at the fifth floor level. A portion of the north wing is carried over the stage, several columns being supported by a truss in the proscenium wall, but this feature of supporting the superstructure over an open space is less extensive than in some other buildings of the same class. Entrance archways three stories high and a broad lobby extending through the first floor to the theater, necessitated special features in the structural arrangement, while the wind-bracing connections are of an unusual design.

A first-floor plan and typical cross-section of the building and tower are given in Figs. 2 and 3. The foundations are concrete piers carried down by the pneumatic process to hardpan at about 100 ft. below sidewalk level, and capped with heavy reinforced-concrete girders, as described in *Engineering News-Record* of Jan. 21, 1926, p. 109. In exterior treatment, the walls are of terra-cotta, having vertical reveals or recesses to break up the flatness of the high wall surfaces.

General Arrangement—Besides the insurance company's offices, some of the floors will be assigned for rental for general office purposes. The second floor and floors up to the 18th have been taken by the Deshler Hotel for use as an annex to the present hotel, which is separated from the Broad St. wing of the new building by Wall St., a narrow thoroughfare to be spanned by an enclosed bridge. A tunnel will connect the basements of the two buildings. Owing to the slope of the ground, the second floor of the insurance building is only slightly higher than the first floor of the hotel.

Stores occupy the greater part of the first floor. Main entrances from the two principal streets lead into a lobby with six elevators serving the offices, and there is also a wide stairway leading up from this lobby. Three of the elevators ascend to the 28th floor, one to the 35th floor and two to the 37th floor. On the Front St. side is a passage leading to an open court between the main building and the theater, this court also providing access to the service entrance of the hotel and the three service elevators. The three passenger elevators of the hotel are not accessible from this floor, as will be seen by the plan. On the Broad St. side is the entrance to the 36-ft. theater lobby, which lobby has also a wide exit doorway on the Wall St. side. A side entrance with stairway is provided on Lynn St. The second floor will have a convention hall and other

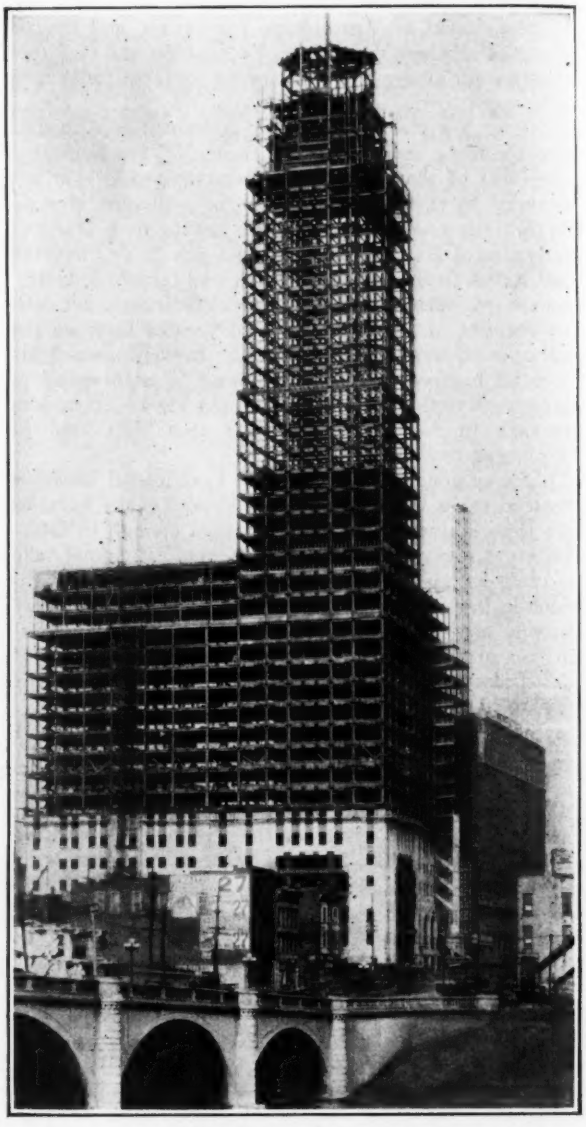

FIG. 1—AMERICAN INSURANCE UNION BUILDING; COLUMBUS, OHIO
Tower of 47 stories, 555½ ft. above street.

special facilities for the hotel, a bridge connecting this floor with the main or office floor of the hotel.

Above the 16th floor the plan dimensions of the wings are reduced, the wall columns being set back about 10 ft. 9 in., as shown by the cross-sections. The roof of this main part of the building is at the level of the 19th floor of the tower, which then continues as a rectangular structure, 76x79 ft., to the 27th floor. Above this it is octagonal, varying in shape at different levels to accord with the architectural treatment. Offices may be arranged up to the 37th floor, above which the tower floors serve only for observation and storage purposes and will be accessible by stairs and a shuttle elevator.

Girders and Floor Framing—While the general floor systems consist mainly of I-beams, girders are required in the third floor framing to support superstructure columns over open spaces. The third floor framing, which is typical, is shown in Fig. 4. Ten columns in the Broad St. wing, including two wall columns, are supported by girders over the theater lobby. In the Wall St. side, the end of one of these girders is framed against a spandrel girder 27 ft. long and 9 ft. deep. This was necessary on account of a wide exit doorway from the theater lobby, which made it impracticable to place columns. The spandrel girder extends across this opening.

These girders could not be placed at the second floor level, since they would have projected below the ceiling of the lobby. As a pipe space 6 ft. 6 in. deep had been provided below the third floor, the girders were placed in this space and the second-floor framing was suspended from them. All these are double girders of 48-ft. span, with webs 64 and 68 in. deep and having 14-in. H-beam stiffeners between the webs under the superstructure columns, as shown with other details in Fig. 6. They are cased in metal lath and 2-in. cement plaster for fireproofing.

In the Front St. wing, six interior columns are carried over a convention hall or ball room on the second floor, by single-web 50-in. girders of about 27-ft. span in the third floor. These are also encased in fireproofing, and are concealed by a suspended ceiling. At the 16th floor, where the width of the wings is reduced, with upper wall columns set back 10 ft. 9 in. from the building line, these columns are carried by 28-in. H-girder beams of 16-ft. span. At this level, also, two of the wall columns of the tower, Nos. 32 and 47 (see Fig. 4), are offset 3 ft. 6 in. along the line of the exterior wall. Here the upper columns are seated on a 60-in. plate girder, as shown in Fig. 5.

In the end connections of floorbeams, the typical construction consists of top and bottom shelf angles in addition to the web connection angles, all riveted against the flange face of the column, as shown in Fig. 6. This drawing shows also the typical end connection

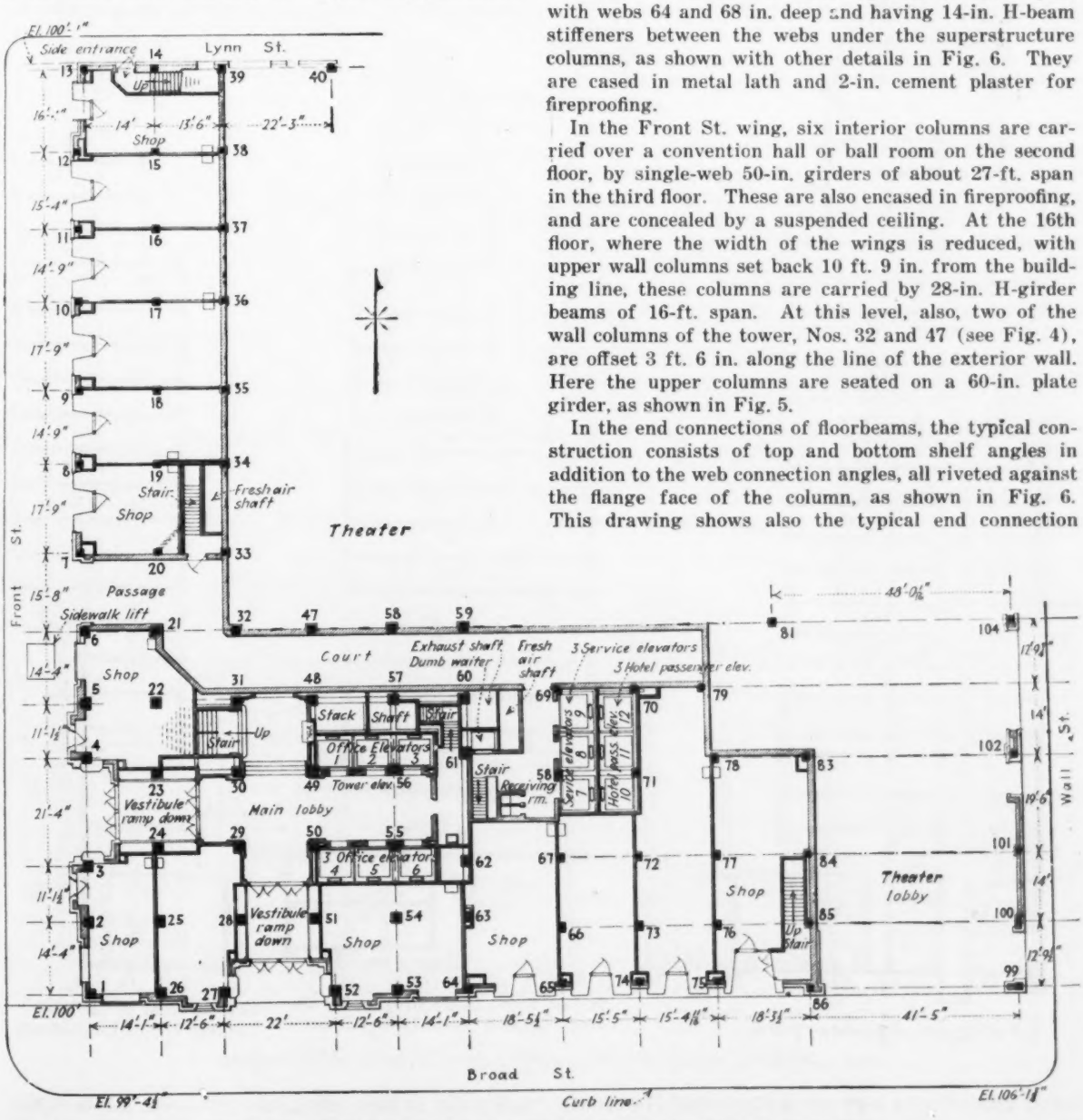

FIG. 2—FIRST FLOOR PLAN OF AMERICAN INSURANCE UNION BUILDING
Broad St. slopes down to Front St.

for tie beams, with top and bottom shelf angles riveted to the web of the column.

Columns—The columns are of H-section, from 8- to 14-in.; those in the wall are 14-in. rolled H-columns. The columns in the lower stories of the tower weigh 288 lb. per foot and have cover plates which in some instances aggregate 24x3¾ in. The maximum column loads on the steel slabs forming the bases are 2,294,000 lb. for combined live- and dead-load. Except for the few special cases where girders are required, as noted above, the floor framing consists of I-beams and H-beams between the columns, with occasional subdivision of the panels, as at stairways and elevator shafts. Panels range from 14⅔x13½ ft. to 19½x16 ft.

Concrete Foors—All floors are of concrete, both solid flat-slab and slab-and-joist construction being used. Solid slabs supported on four sides are used in the tower, in order to provide at each floor a rigid diaphragm to stiffen the structure against wind pressure. The arrangement of columns in the tower is such that the panels are practically square, making the use of slabs with two-way reinforcement economical, and at the same time having practically the same section for floor beam in both directions. Concrete slab-and-joist construction was used in the wings, because the column spacing made this design economical. Where openings

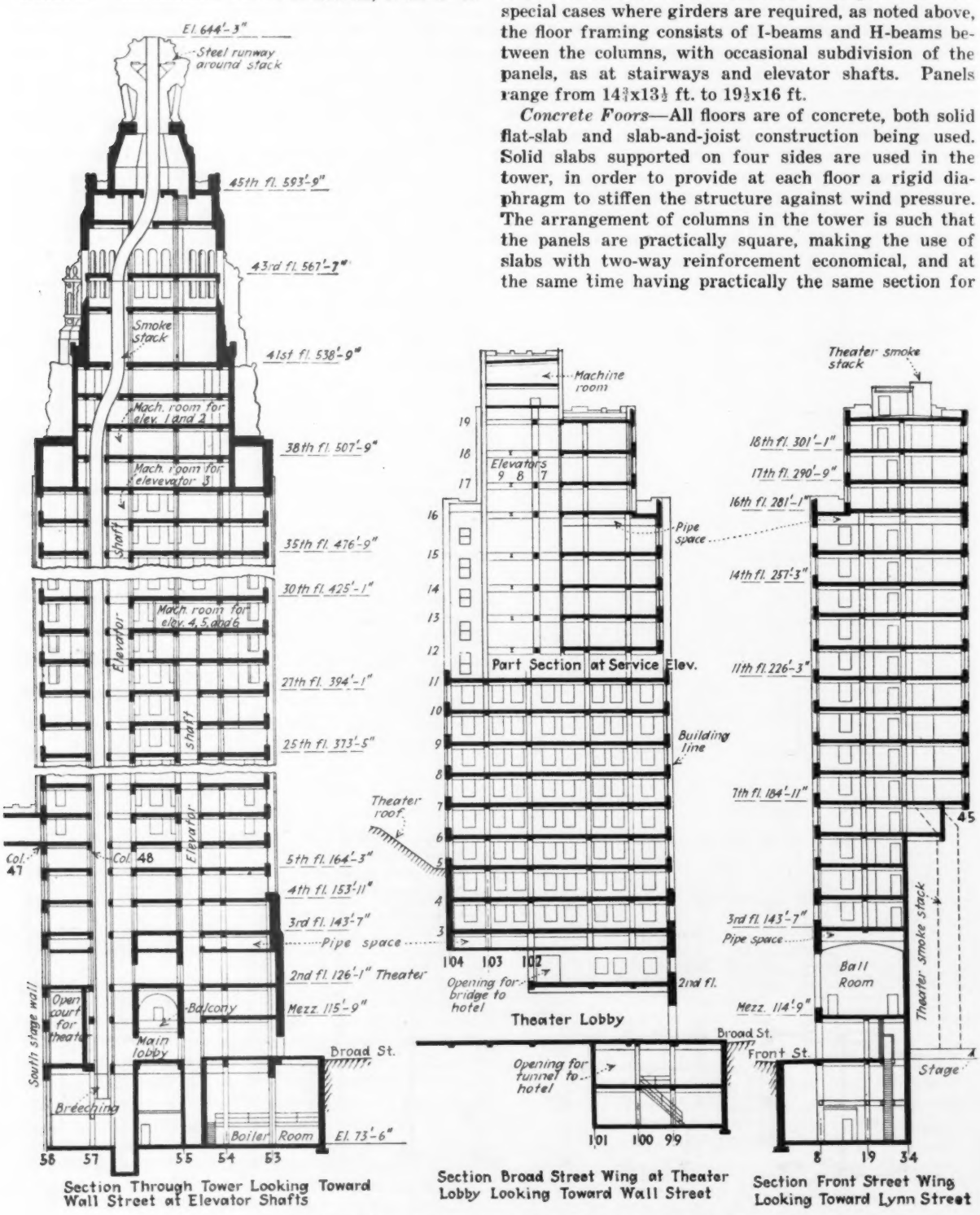

FIG. 3—TYPICAL CROSS-SECTIONS OF BUILDING WITH 47-STORY TOWER

are required for piping or ducts, the slabs are reinforced by concrete beams. Typical floors are designed for a live-load of 60 lb. per square foot.

Spandrels and Wind Bracing—Special attention to wind bracing is required in the tower owing to its great height and relatively small horizontal cross-section. In this corner of the building, therefore, from the first to the forty-eighth floor, the tower section, about 76x79 ft., is braced at every floor with plate-girder or large I-beam spandrels on the four sides. Furthermore, the spandrels have deep gusset plate connections to the columns.

These spandrel connections are not made with pairs of angles in the usual way, but with single T-sections, which are shop riveted to the faces of the H-columns. This construction is shown in Fig. 6. The T-sections are formed by splitting rolled H-columns and H-girder beams through the webs. This type of connection was adopted because the flanges of H-beams are thicker than the legs of any angles, while the web allows much more space for riveting than would be given by angles. The arrangement also reduces the number of field rivets in the connections. In erection, the ends of the web of the spandrel beam are lapped against those of the T-connections on the faces of the columns and the gusset splice plates (shop riveted to the beam) are field riveted to the T-connections. At some points the T-bars are riveted to the webs of the columns, instead of to their faces.

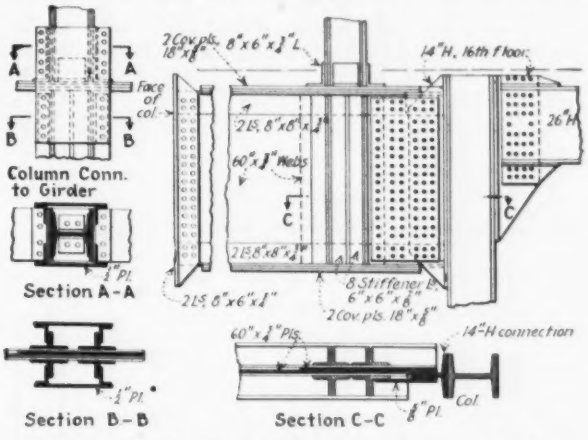

FIG. 5—WALL COLUMNS OFFSET AT 16TH FLOOR

In the third story of the tower, specially large spandrel girders are used, placed above the third and below the fourth floor level, so that with their gusset connections they form practically a portal bracing in each vertical panel. This arrangement, shown in Fig. 7, is made necessary by the lofty arched entrances on both sides, which extend through three stories and thus interrupt the spandrel connection and bracing at the

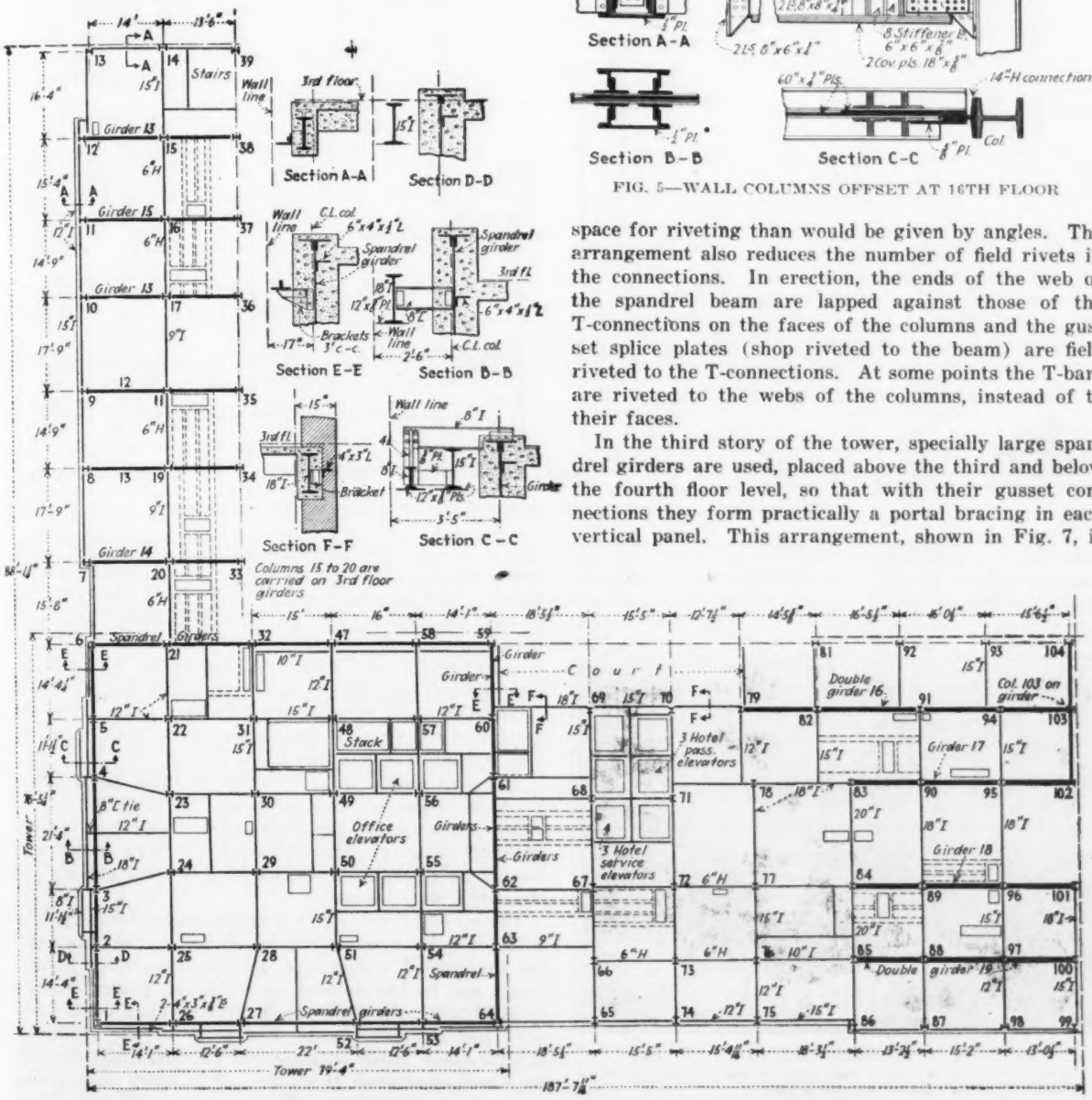

FIG. 4—FRAMING PLAN OF THIRD FLOOR, SHOWING GIRDERS

mezzanine and 2d floor levels. In the 18-story wings, the I-beam spandrels have no gusset plates, the angle connections giving sufficient rigidity for wind bracing.

Engineers, Architects and Builders—This building was designed by C. Howard Crane, as architect for the American Insurance Union; Arton E. Yokom is structural engineer; Ray S. Wilde, mechanical engineer, and Roger L. Waring, field superintendent for the architect. All these are of Detroit. The general contractor is John Gill & Sons, Cleveland, Ohio. Steel was fabri-

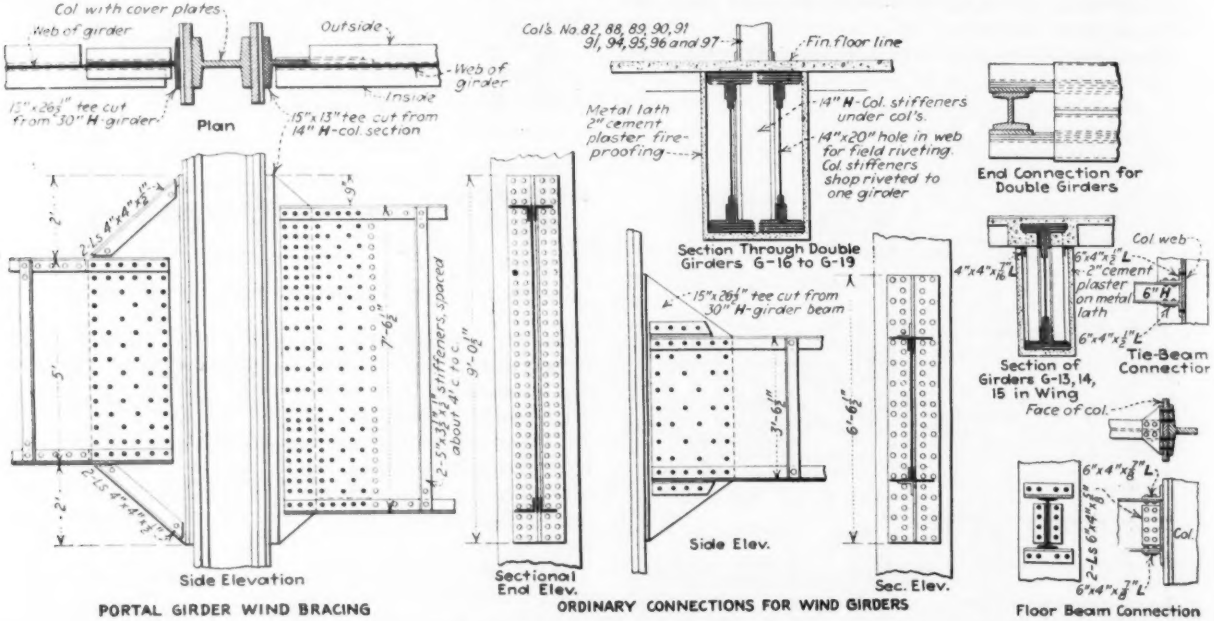
Col. with cover plates
Web of girder
Outside
Web of girder
Inside
15"x26½" tee cut from 30" H-girder
Plan
15"x13" tee cut from 14" H-col. section
Side Elevation
Sectional End Elev.
PORTAL GIRDER WIND BRACING
Col's. No. 82, 88, 89, 90, 91 91, 94, 95, 96 and 97
Fin. floor line
Metal lath 2" cement plaster fire-proofing
14" H-Col. stiffeners under col's.
14"x20" hole in web for field riveting. Col. stiffeners shop riveted to one girder
Section Through Double Girders G-16 to G-19
15"x26½" tee cut from 30" H-girder beam
Side Elev.
Sec. Elev.
ORDINARY CONNECTIONS FOR WIND GIRDERS
End Connection for Double Girders
Col. web
2" cement plaster on metal lath
6" H
Section of Girders G-13, 14, 15 in Wing
Tie-Beam Connection
Face of col.
Col.
Floor Beam Connection

FIG. 6—WIND BRACING GIRDERS AND BEAM FRAMING IN BUILDING AT COLUMBUS

cated by the McClintic-Marshall Construction Co., and was erected by the Bass Construction Co. The city's Department of Buildings engaged the Morgan Engineering Co., of Columbus, to check the structural design;

FIG. 7—HEAVY PORTAL BRACING IN TOWER
Entrance archways three stories high interrupt spandrels and necessitate special spandrel bracing above.

in this work the company was assisted by Prof. Clyde T. Morris, of Ohio State University, who also conducted the foundation tests described in the previous article already noted.

Municipal Progress at Lubbock, Texas

By H. N. Roberts
Hawley & Roberts, Consulting Engineers

THAT part of western Texas known as the Plains Country, or by its old Spanish name of the Llano Estacado, is a vast stretch of country which was almost undeveloped until a few years ago. Although its annual rainfall is only 8 to 40 in., with an average of 24 in., it has been found that many crops can be raised abundantly by suitable farming methods. In 1910, Lubbock, which is the principal city of the South Plains district, had a population of only 1,000, but this increased to 3,000 in 1920 and 15,000 in 1925. The need of this section for an educational institution similar to the University of Texas and the Texas Agricultural and Mechanical College was recognized by the State Legislature, and in 1923 Lubbock was selected as the location for the new Texas Technological College, which was opened in September, 1925.

The area within the city limits is about 2,600 acres. In 1924-25 the city laid 13 miles of water mains, 15 miles of sewers and 120 blocks of brick paving, besides building four reinforced-concrete storage reservoirs having an aggregate capacity of 2,050,000 gallons for the city's water supply.

Paving—The subsoil is a sandy loam overlying 2 to 6 ft. of a lime formation locally known as "caliche." As the subsoil drains well, its compressibility is uniform, and as the rainfall is light, the paving chosen in 1924 was principally 2½-in. vertical-fibre brick on a 4-in. lean concrete base. For some of the residence streets a 3-in. brick with asphalt filler was laid directly on a well compacted subgrade. This latter paving has been very satisfactory. The contract price was $2.33 per sq.yd. as against $3.03 for the concrete-base type. The city paid 25 per cent of the cost in each district (exclusive of curb cost in front of property) and this gave an assessment of $4.50 per front foot for the

residence property on a 30-ft. width of paving on natural base.

Sewers and Sewage Disposal—Nine miles of 15- to 78-in. storm sewers were built at a cost of $234,000. The material used was vitrified tile for sizes from 15 to 21 in., lock-joint reinforced-concrete pipe from 24 to 30 in., and monolithic plain concrete for 33 to 78 inches.

Sewage-works built in 1922 consisted of an Imhoff tank, sprinkling filters, secondary settling tank and chlorination apparatus. The effluent was discharged into Yellowhouse Canyon, but as the canyon is dry for the greater part of the year many complaints were received. In 1925 the city had studies made as to using the effluent for land irrigation, which method of final disposal should be especially desirable in the semi-arid regions where water is in demand. As a result the city bought 100 acres of land about 1½ miles southeast of the sewage-works and leased it for five years to private parties who will grow alfalfa and fodder irrigated with the treated sewage.

All engineering work on city improvements since 1924 has been done by Hawley & Roberts, consulting engineers, the writer being in charge at Lubbock.

Steel Contractor Not Liable for Knickerbocker Deaths

Important Ruling by District of Columbia Supreme Court in Matter of Collapse of Theater in Washington Four Years Ago

A RECENT decision of the Court of Appeals of the District of Columbia in a suit resulting from the collapse of the roof of the Knickerbocker Theater, in Washington, on Jan. 28, 1922, declares that the steel contractor is not liable for negligence in designing and constructing the roof. The court holds that as a general rule, established by long precedent, the contractor is not liable to a third party after completion and acceptance of his work by the owner, there being no privity of contract existing between the contractor and the injured third person; and that the several recognized exceptions to this general rule do not apply to the present case.

The case arose from a suit by Guy Sturgis, administrator of the estate of a person killed in the collapse of the theater against the owner of the theater, the architect, and the steel contractor. The steel contractor, Ford, demurred but was overruled in the lower court. The present decision, on Ford's appeal, upholds the demurrer. The decision, written by Chief Justice Martin, says in part:

> The general rule is well established that the negligence of the contractor in constructing a building will not render him liable to a third person who is injured in consequence thereof after the work has been completed and accepted by the owner of the building. 20 R.C.L. 49. "After completion and acceptance of a building the liability of the builder for accidents caused by defective construction ceases and the liability attaches to the owner, whether the damage is attributable to his own negligence or to that of the builder." 9. C.J. 751. Thompson on Negligence, Vol. VI, p. 465.
>
> . . . In *Mayor of Albany vs. Cunliff*, 2 N.Y. 165, it was held that builders of a public work are answerable only to their employers for any want of reasonable care and skill in executing their contract, and they are not liable to third persons for accidents or injuries which may happen to them from imperfections of the structure after the same is completed and has been accepted by the employers. This ruling is cited with approval by Mr. Justice Clifford in *Savings vs. Ward*, 100 U.S. 195, 204.
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> In *Daugherty vs. Herzog*, 145 Ind. 255, the defendant contracted with the owner to remodel and in part reconstruct a building. He completed the work and turned the building over to the owner. Afterwards the building collapsed because, as was alleged, of defendant's negligence, causing the death of a third person. It was held upon demurrer that the contractor was not liable in damages to the third party.
>
> In *Curtin vs. Somerset*, the defendant contracted with a company to erect a hotel. After it was completed and accepted, the plaintiff, a guest in the hotel, was injured by the fall of a porch, due to inferior construction and a failure of the defendant to comply with the plans and specifications. A recovery was denied and the general rule above stated was applied. "The consequences of holding the opposite doctrine," says the Court, "would be far-reaching, for a contractor who erects a house, who builds a bridge, or performs any other work; a manufacturer who constructs a boiler, piece of machinery, or a steamship, owes a duty to the whole world, that his work or his machine or his steamship shall contain no hidden defect. It is difficult to measure the extent of his responsibility, and no prudent man would engage in such occupation upon such conditions. It is safer and wiser to confine such liabilities to the parties immediately concerned."
>
> "There is no rule under which a third person may recover damages against a builder or contractor for an injury sustained by reason of defective construction if the thing constructed is not inherently and necessarily dangerous, when injury did not occur until after the builder or contractor had parted with the possession and title. The liability of the builder or contractor for defective construction is to the person with whom he was under contractual relations and a stranger can hold him liable after he has parted with possession only under exceptional circumstances." Lurton, Circuit Judge, in *Saliotte vs. King Bridge Co.*, 122 Fed. 378, 381.
>
> This doctrine is supported by many authorities, among which are the following cases brought by third parties against contractors for injuries occurring after acceptance of the construction by the employer: *First Presbyterian Congregation vs. Smith*, 163 Pa. St., 561 (defective sewer); *Cunningham vs. T. A. Gillespie Co.*, 241 Mass. 280 (defective sidewalk); *Galbraith vs. Illinois Steel Co.*, 133 Fed. 495 (defective steel support, storage tank); *Williams vs. Edward Gelten Dock B & C Co.*, 258 Fed. 591 (unguarded breakwater in lake); *Thomas vs. Lane*, 221 Mass. 447 (defective handrail upon steps); *Thornton vs. Dow*, 60 Wash. 622 (defective balcony railing); *Burdick vs. Cheadle*, 26 Oh. St., 393 (defective shelving in store room); *Collie vs. Selden*, L.R. 3 C.P., 495 (negligent hanging of chandelier); *Field vs. French*, 50 Ill. App. 78 (defective elevator).
>
> . . . It is true that certain alleged exceptions to the general rule are recognized by the authorities. These may be classified as follows: (a) An act of negligence of a manufacturer or vendor which is imminently dangerous to human life and health, and which is committed in the preparation or sale of articles, like foods and poisons, whose primary use is to serve, destroy or affect life and health (*Thomas vs. Winchester*, 2 Seed. 397); *Waters-Pierce Oil Co. vs. Deselus*, 212 U.S. 159; compare *Cadillac Motor Car Co. vs. Johnson*, 221 Fed. 801; S.C. 261 Fed. 878; and *MacPherson vs. Buick Motor Co.*, 217 N.Y. 382. (b) The negligence of an owner who expressly or impliedly invites third parties to use defective machines or instruments manufactured or furnished by him (*Coughtry vs. Globe Woolen Co.*, 56 N. Y. 124). (c) Where the manufacturer or vendor, without giving notice of its character and qualities, supplies or delivers to another a machine or article which at the time of delivery he knows to be imminently dangerous to the life and limb of anyone who may use it for the purpose for which it is intended (*Hurst vs. J. I. Case Threshing Machine Co.*, 120 Fed. 865; compare *Marquardt vs. Ball Engine Co.*, 122 Fed. 374; *O'Brien vs. Amerisan Bridge Co.*, 110 Minn. 364; and *Heiser vs. Kingsland & Douglas Mfg. Co.*, 110 Mo. 605). (d) Where the manufacturer or constructor has full knowledge of the defects rendering the article or structure dangerous, but wilfully conceals the same (*Keulling vs. Roderick Lean Mfg. Co.*, 183 N.Y. 78; *Penn Steel Co. vs. Elmore & Hamilton C. Co.*,

175 Fed. 176; compare *Lebourdais vs. Vitrified Wheel Co.*, 194 Mass. 341). (e) Where the article or structure is a nuisance *per se*, in which case negligence is immaterial, *Washington Ry. & Electric Co. vs. Washington Terminal Co.*, 44 App. D.C. 470.

We think it clear that the declaration does not bring this case within any of these exceptions, nor does the rule of *res ipsa loquitor* serve such a purpose against appellant Ford; the case is left therefore to be governed by the general rule aforesaid. Many of the almost innumerable decisions upon this subject have been collected and classified by Sanborn, Circuit Judge in *Hurst vs. J. I. Case Threshing Machine Co., supra.*

Laying 42-In. Concrete Pipe Sewer On Ocean Bottom

Work Damaged by Earthquake Restored—Derrick Barge Lowered Pipe Singly to Diver—Jointing Done Under Water

SUCCESSFUL methods of laying and jointing submerged concrete pipe in single 12-ft. lengths were worked out by trial in building the new sewer outfall into the ocean at Santa Barbara, Calif. Toward the end of the work in some 45 ft. of water a barge load of five sections was laid and jointed with ease each day, and often, could the pipe have been delivered, additional sections could have been laid. The details of spotting and connecting up the pipe lengths under water by lines to the derrick barge and to a winch on shore are outlined here. The method may be studied with benefit in comparison with the similar outfall structure at Santa Monica Bay, near Los Angeles, as described in *Engineering News-Record*, Aug. 20, 1925, p. 292.

The construction of the 42-in. concrete outfall sewer into the Pacific Ocean at Santa Barbara had been completed about 350 ft. from the shore line when the work was interrupted by the earthquake of June, 1925. After the earthquake damage was repaired, the outfall was continued to a point 3,214 ft. offshore where it terminates in a water depth of 45 ft. From the screening plant, whose equipment was noted in *Engineering News-Record*, July 1, 1926, p. 19, the effluent enters the outfall about 600 ft. from the mean low tide line. For this distance, the outfall was laid in beach sand. From the shore through the breaker line, a further distance of 280 ft., the pipe was placed within the protection of a cofferdam and was also supported on capped piling which was continued to a point 700 ft. from the beach line. Beyond the piling the pipe was laid on the ocean bottom in a trench dredged for the most part in solid blue clay. The pipe sections are 12 ft. long, 6¾ in. thick and contain a double reinforcing cage with steel embedded at least 2 in. from the surface. The sections, which were cast in a yard on the beach, weigh 6¼ tons each.

Repairing Earthquake Damages—After the earthquake, the pipe on shore and in the cofferdam showed a vertical displacement from grade of as much as 15 in. at three points. The mastic in the joints had squeezed out, leaving openings but, with the exception of a few minor fractures, the pipe sections were intact. There was also some opening of joints and slight disturbance of alignment in the ocean section, but this was not as extensive as on shore and was not regarded as at all serious.

Repairs on that portion of the outfall between the screening plant and the ocean were made by excavating to grade on each side of the pipe with a clamshell dredge after which the trench was dewatered and men with shovels removed sand from beneath the line, starting at the highest point of uplift and working back toward that portion of the line remaining at grade. The three points raised 15 in. were restored to grade in this way without diffculty, the pipe settling back to place as the sand was removed, without breaking the joints.

Sand that had collected inside the outfall during the delay in the work at the time of the earthquake was washed out by placing the discharge end of a 12-in. suction pump in a manhole at the beach end of the line and pumping ocean water through the outfall. A diver then entered the outfall end and calked all open joints with lead wool. There was no difficulty in making tight joints by the calking process except that above the spring line it was necessary to use a very pure grade of lead wool. After experience with unsatisfactory wool coming out, specifications were made to require wool 99 per cent pure. Where the bell ends had been cracked off rings of concrete, reinforced, were cast around the damaged joints. Only three breaks in the bell ends were found, the largest of which was about 2 ft. long. Repairing the earthquake damage required about 30 days.

Pipelaying Procedure—For that section of the line built within the protection of the cofferdam, the pipe sections were delivered on a gantry supported on piling built into the cofferdam for this purpose. On the ocean end of the work the method tried first was to float the sections into place with pontoons. This was not a success; it was found impracticable to get the sections into proper position. The procedure was then changed to lowering the sections into place by a derrick on a barge.

The derrick barge was anchored by three cables, one extending to an anchor directly offshore and two breasting cables carried almost at right angles to the offshore cable and also held by anchors. The anchors for these breasting cables were placed slightly inshore from a line at right angles to the offshore anchor, thus preventing the barge from drifting seaward with tidal currents.

Before the derrick picked up each section from the barge on which it was delivered, three cables were attached to it: (1) One from the forward bitt on the barge of a length predetermined for this pipe section so as to bring it into proper position on the ocean bottom with respect to length of the outfall; (2) one from the pipe section to a winch on shore, buoyed up over the intervening distance on barrels; and (3) a lowering cable from the derrick boom which was attached to a sling around the section. With this arrangement and with the section delivered in position on the trench bottom, the strain line to the winch on shore was drawn taut until the barrel nearest the derrick barge was pulled under and the second barrel was just awash. This was found to be just the strain at which only a slight lifting and shoving by the diver was necessary to start and direct the section, the strain in the line to the winch being sufficient to thrust the section firmly but not too forcefully into position. This operation was facilitated and controlled by the use of telephones between diver, barge crew and winchman on shore.

The biggest problem on the job was the matter of joints, both as to design and as to methods of handling them in the process of laying the sections. At the outset too much of the asphaltic compound was used in preparing the joints for laying and as a result the

pipe sections were not always tightly seated with concrete against concrete at the outer periphery of the joints. Some joints made in this way were damaged by the surging and the variation of internal and external pressures caused by wave action so that the compound was "blown" and had to be repaired by calking with lead wool from the inside. Later, using a smaller quantity of mastic—barely enough to fill the space between adjoining surfaces—joints were secured which are believed to be entirely satisfactory.

The best means of heating the compound used in the joints was found to be the simplest one—exposure to the sun before application to the pipe sections waiting to be loaded on the barge. Using a forge for heating introduced the risk of overheating and driving off of volatile elements which would leave the compound brittle. On cloudy days forge heating had to be employed, but when this was done great care was used to avoid overheating.

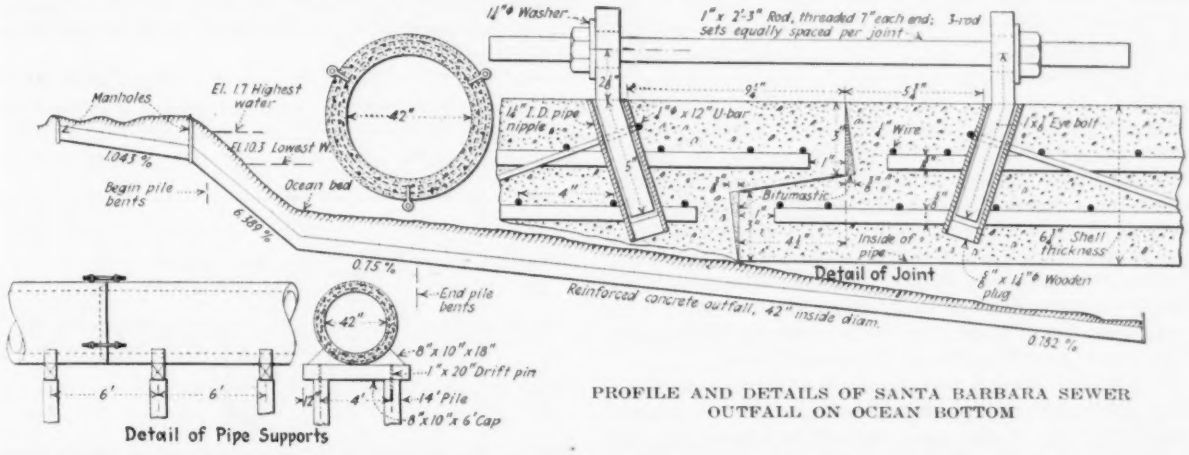
The joints first laid were made wholly with the asphaltic compound. Later, it was found that a better job could be obtained by using a rope of oakum with loose strands, which was put on the bell end of the pipe and coated with liquid bitumastic to hold it in place until the joint was entered. The theory is that if any disturbance of line or grade opens a joint made in this way the oakum will swell and keep it tight; this the mastic alone will not do.

The original plan was to terminate the outfall in an elbow. This was abandoned when trouble with an outlet of this type at Hyperion was reported. In lieu of the elbow the last eleven outfall sections were gradually brought up to the bed of the ocean so that the discharge end terminated a foot above the ocean floor. The last section rests in a cement cradle made by depositing sacks of dry cement about it and carrying these up to the spring line of the pipe.

The winch on the barge was a special, electrically-driven rig with 11 drums, all of which were found useful at different times in this operation. The winch was provided with a single 50-hp. motor which was ample as only rarely were more than one or two drums required at one time. Motive power was supplied by a 440-volt cable from shore to barge where a reel was mounted that could pay out the cable as the barge moved seaward.

The barge crew consisted of 17 men and although the rate of laying the pipe was slow at first the speed steadily increased as methods were developed and the crew became more expert. On the last day of the job five sections were laid with the diver below only 1 hr. 45 min.

The rate of laying sections was controlled to a large extent by the speed at which they could be delivered. Sections could be delivered fast enough from the casting yard via the pile trestle on the cofferdam to a barge moored alongside, but only one barge, with a capacity of five sections, was available at Santa Barbara. It was not considered worth while to build another barge at Santa Barbara or to pay, in addition to rent, the considerable towing charge incidental to bringing another barge 150 miles from San Pedro. Toward the close of the work progress was so rapid that five sections did not suffice for a full day's work but there was insufficient time to make a second round trip with the one barge delivering from shore to derrick-barge. In January, 74 sections were placed in 21 working days. Practically all of February was lost on account of storms and rough water and in the last 21 working days in March, 105 sections were laid.



PROFILE AND DETAILS OF SANTA BARBARA SEWER OUTFALL ON OCEAN BOTTOM

The outfall was placed by J. H. Tillman Co., contractors. E. E. Haskell is city manager of Santa Barbara and C. W. Moore is city engineer. L. R. Walker is assistant city engineer in charge of sewage disposal.

Railway Use Near Saturation in Denmark

Railway construction in Denmark may be considered practically to have reached the limit of its development, according to the report, to the U. S. Department of Commerce, of the Danish commission that recently investigated the advisability of discontinuing railroad construction in Denmark in view of the increasing use of the automobile. The commission recommends that thirty-four of the forty railroad projects which have received the approval of the Danish Parliament be abandoned outright, and that in the case of three others construction be made provisional, thus leaving only three roads of the projected forty. A prime reason for the commission's recommendations is said to be the rapid development in recent years of Danish bus traffic, and a later committee will take up the questions arising in connection with bus transportation, such as co-ordination of bus and railroad traffic, establishment of state bus routes, and state support of bus traffic through subvention.

Factors Governing Air Inlet Valves on Pipe Lines

Study of Maximum Rate of Air Space Formation in Pipe and Required Inlet Capacity—Data Needed in Designing Pipe Against Failure from Possible Vacuum

By D. C. Henny
Consulting Hydraulic Engineer, Portland, Ore.

PIPE LINES are subject to a number of vicissitudes aside from stresses due to static or ordinary hydraulic pressure. Such elements as reduction of capacity by sediment or by air accumulation at summits are simple and readily provided for by blow-offs and automatic- or hand-controlled air valves. The effect of water ram has been the subject of experiment and elaborate mathematical treatment. There is one danger to pipe lines which seems to have received relatively small attention so far as is indicated by engineering literature, namely the extent to which provision is justified or essential for air inlet valves to prevent collapse under unforeseen conditions. Yet the need of study in this direction is strongly emphasized by numerous accidents in long water conduits and penstocks which have been the cause of serious damage. The subject was called home to the writer when he was confronted with this problem in connection with the design of a 30-mile pipe line for water supply, a problem the more serious because much of the conduit is to be constructed of light steel and the line passes through hilly country with numerous breaks in grade.

A possible reason for the lack of information on this subject is the realization that little is known regarding one of the most essential elements of the problem, namely the strength of the pipe shell to stand up under a reduction of interior pressure below atmospheric. Theoretically, if the pipe is truly round and if the backfill is well tamped without causing deformation, any ordinary pipe, even if built of thin steel plate, should have abundant strength to resist atmospheric pressure when a complete vacuum exists on the inside. The pressure then is radially inward and in the case of a 24-in. No. 10 gage steel pipe would stress the steel to only 1,300 lb. per square inch.

Air Inflow to Prevent Collapse—It is well known that collapse when it occurs is not due to lack of compressive strength in the steel of a round pipe but to its lack of strength as an arch when deformed and carrying unevenly distributed loads. The degree of deformation which a pipe may have suffered when finally in place and the unevenness of the loading of backfill are elements which cannot be arrived at by mathematical treatment and, as a basis, therefore, of the ability of the pipe shell to resist exterior pressures as an arch, the best that can now be done is to assume a certain degree of interior pressure reduction which the pipe can safely stand, it being readily possible, of course, aside from applying general judgment, to test this matter by experiment in the field on individual backfilled pipe sections.

The great uncertainty thus necessarily involved in a satisfactory treatment of the problem does not justify ignoring other elements which can be more definitely determined to the end that on some given reasonable assumption there shall at least be an equal degree of safety along the entire pipe line and a consistency in the extent to which protection from collapse is provided. The writer, therefore, made a study of the other factors entering into the problem, namely the maximum rate at which air space is formed in the pipe, assuming a wide-open break at crucial points, and the required inlet capacity and size of valves to permit air to enter and to prevent atmospheric pressure reduction greater than what may be somewhat arbitrarily agreed upon as permissible.

The rate of required air inflow depends, aside from the permissible pressure reduction, upon the controlling grades and the diameter of the pipe. Let Fig. 1 represent a condensed pipe profile with exaggerated vertical

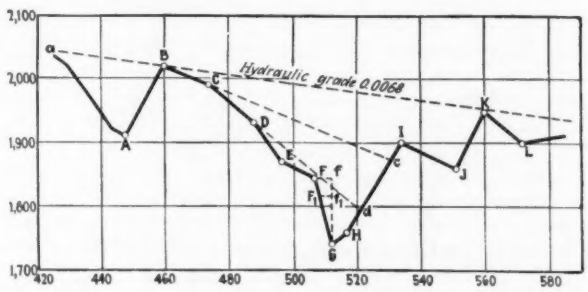


FIG. 1—ASSUMED PROFILE OF 21-IN. PIPE LINE

scale, and consider first point *B*. There are several possibilities of pipe break which would affect air inflow at this point. The most serious would be a break upstream at *A* or downstream at any point below *Cc*.

Considering a break at *A*, the water column in *BA* will quickly reverse its previous direction of flow and thereafter have its velocity towards *A* rapidly accelerated until it closely approximates the maximum when pipe friction consumes the entire grade. In the meantime the water in *BC* will continue at a slowly decelerating rate in the direction of *C*. The rate of separation of the water columns *BA* and *BC* will in a short time reach its maximum and the problem involves the determination of this maximum, *BA* and *BK* being in such case the principal controlling grades. If on the other hand a break takes place in the pipe at some point below the line *Cc*, the water column *BC* will become speeded up in its original direction of flow tending to cause air space at *B*, but this tendency will be partially neutralized by inflow past *B* from above. In that case the grades *aB* and *BC* will become controlling.

As to point *C*, only one case need be considered, namely, a break below the line *Dd*, when air inflow at *C* will be controlled by grades *BC* and *CD* (point *a* lying below the extension of *BC*). Then again there will be a compensating effect produced by inflow past *C* from above. For point *F*, with break at *G*, the grades *DF* and *FG* will be determinative. For point *I* control will

be either from BI and IJ (break at J) or from IH and IK (break at H). It is obvious that points of re-entrant grade like A, E, G, H and J require no air inlets and need not be considered.

The rate of acceleration in a pipe line on a grade with wide open break at its bottom involves the angle α which the pipe grade makes with the horizontal, the pipe friction and the difference (if any) in atmospheric pressure. Neglecting the latter element for the moment, the accelerating force is the gravity component in the direction of the pipe, which may be expressed by $q \sin \alpha$, q being the weight of water in 1 ft. of pipe. This is opposed by pipe friction $qi = q\frac{v^2}{rC^2}$ (Chezy formula) in which i is the hydraulic grade.

In order to avoid impractical complexity of formulas, it will be assumed that C for any given diameter of pipe is constant. Thus: Accelerating force $q\left(\sin\alpha - \frac{v^2}{rC^2}\right)$ and correspondingly Mass $\frac{q}{g}$ and therefore

$$\frac{dv}{dt} = g\left(\sin\alpha - \frac{v^2}{rC^2}\right) = A - Bv^2 \qquad (1)$$

in which $A = g \sin\alpha$ and $B = \frac{g}{rC^2}$. From formula (1) we have $dt = \frac{dv}{A - Bv^2}$ which integrated gives:

$$t = \frac{1}{2\sqrt{AB}} \log_e \frac{\sqrt{AB} + Bv}{\sqrt{AB} - Bv} + k \qquad (2)$$

In above formula (2) k is zero since for $v = 0$, $t = 0$. This formula may therefore also be written:

$$t = \frac{C\sqrt{r \sin\alpha}}{2g \sin\alpha} \log_e \frac{C\sqrt{r}\sin\alpha + v}{C\sqrt{r}\sin\alpha - v} \qquad (2a)$$

The maximum value of v may be found by making $\frac{dv}{dt} = 0$, when $\sin\alpha - \frac{v^2}{rC^2} = 0$. Therefore Max. $v = C\sqrt{r \sin\alpha}$, which value is reached when the entire pipe grade is consumed by friction.

With the aid of this formula curves may be constructed with t as ordinates and v as abscissas, as shown in Fig. 2 for a 21-in. pipe with $C = 110$, approximately equivalent to $n = 0.012$ in the Kutter formula. Turning again to Fig. 1 and considering the required capacity for an air inlet valve at B in the case of a pipe break at C with free outflow it will be noted that the water column BC velocity v_2 in col. BC will be greater than v_1 in col. AB and that the rate of pipe emptying at B will depend upon $v_2 - v_1$. From the curves in Fig. 2 it will be seen that the time when $v_2 - v_1$ is greatest is about at the end of 8 seconds and that thereafter it becomes smaller, tending towards Max v_2 — Max. v_1 which is practically reached in twice that time, or 16 seconds. From Fig. 2 the following table was prepared:

Pipe Grade	Max. v	Max. v_2—Max. v_1	Max. (v_2-v_1)	Max. (v_2-v_1) / Max. v_2—Max. v_1
0.05	16.2			
		6.8	8.0	1.177
0.10	23.0			
		5.2	6.2	1.192
0.15	28.2			
		4.3	5.1	1.162
0.20	32.5			
		3.8	4.6	1.210
0.25	36.3			
0.05	16.2			
		12.0	14.3	1.192
0.15	28.2			
		8.1	9.8	1.210
0.25	36.3			
0.05	16.2			
		20.1	23.3	1.159
0.25	36.3			

If we make

$$\text{Max.}\,(v_2 - v_1) = s(\text{Max.}\,v_2 - \text{Max.}\,v_1) \qquad (4)$$

we note from the table that the value of s varies from 1.159 to 1.210. Some of the variations are undoubtedly due to inaccuracies in the drawing of the curves. The average value is about 1.19.

Curves like those on Fig. 2 have been constructed for other pipe sizes, the results being tabulated below:

Diameter In.	C	s	Time to Reach Max. (v_2-v_1) Sec.	Time to Approximate Max. v_2—Max. v_1 Sec.
12	100	1.204	5	10
24	110	1.192	8	16
48	128	1.184	14	28

It appears that the variations in the value of s are small in comparison with other uncertainties in the problem and that this value within the range of 12- to 48-in. sizes may be safely placed at 1.2. It is thus possible to avoid the need of constructing curves and to express the maximum rate of pipe emptying at a break in pipe grade like B in Fig. 1 by

$$Q = A\,1.2(\text{Max.}\,v_2 - \text{Max.}\,v_1)$$
$$= 1.2AC\sqrt{r}(\sqrt{\sin\alpha} - \sqrt{\sin\beta}) \qquad (5)$$

in which A is the pipe area, C is the factor in the Chezy formula, r is the hydraulic radius and α and β are the respective angles which the pipe grades below and above the air inlet make with the horizontal.

In case principal or intermediate summits are under consideration, with pipe break in an upstream direction, the maximum rate of air space formation in the pipe is found by adding the maximum velocities, the use of a factor s is unnecessary, and the formula for Q is

$$Q = A(\text{Max.}\,v_2 + \text{Max.}\,v_1)$$
$$= AC\sqrt{r}(\sqrt{\sin\alpha} + \sqrt{\sin\beta}) \qquad (6)$$

Consideration should now be given to a possible difference in air pressure acting upon the ends of the moving water column. Considering a break at G (Fig. 1), the water column will separate at a, B, C, D, and F, each equipped with air valves of the desired size to prevent lower pressures than the predetermined amount which may be called m atmospheres. Then with such reduced atmospheric pressure prevailing, very quickly after the break at all these points, no air pressure difference at the ends of water columns will exist to affect acceleration except in the last section FG. The air pressure difference at this section will be $(1 - m)$ atmosphere.

In studying point F with apparent grade $\frac{fG}{FG}$ it will be necessary to replace this expression by

$$\frac{fG - (1 - mAtm)}{FG}$$

atmospheric pressure being expressed in feet of water.

The application of the above method will generally give correct results. There are cases, however, when individual grades are relatively short, that serious error may be made. If maximum velocity differences occur in about 8 sec. from the moment of the break and if prior to the expiration of this time a large portion of a pipe section like FG in Fig. 1 has become emptied, for instance to F_1, then the apparent grade $\frac{f_1G}{F_1G}$ is still the same as $\frac{fG}{FG}$ but the grade as corrected for atmospheric difference will become $\frac{f_1G - (1 - mAtm)}{F_1G}$, the

correction then having a greater relative influence than before. It is easy in actual cases to test the need of such further correction, which with grades longer than 500 ft. will generally be found superfluous and the omission of which will in any case work towards safety.

For the sake of clarity three cases taken from Fig. 1 will be numerically figured, assuming the pipe line to have an internal diameter of 21 in. (with internal area 2.405 sq.ft. and $r = 0.4375$ ft.) and m to be 0.6 so that maximum atmospheric pressure difference becomes 0.4 atmosphere, or at El. 2,000 12.5 ft. The maximum velocity for any grade sin α by Formula 3 is $C\sqrt{r}\sqrt{\sin\alpha}$. For 21-in. pipe, taking C at 110, the maximum velocity is $72.8\sqrt{\sin\alpha}$.

Considering first point C with break at E, when the controlling grades will be BC and CD, then:

	Elev.	Station	Elev. Difference	Corrected for Atm. Pr.	Distance	Sin α Effect. Grade	Max. v	Diff. Max. v	Correction Factor	Max. Diff. in v	Air Space Increase
B	2020	460									
			30	30	1400	.0214	10.6				
C	1990	474						4.5	1.20	5.4	13.0
			60	60	1400	.0429	15.1				
D	1930	488									

Since air pressure reduction took place at both top and bottom of the water column no correction is necessary and the maximum rate at which air space is formed in the pipe is 5.4 × 2.405 (pipe area) = 13.0 cu.ft. per second.

Studying point F with break at G (Fig. 1) we have as controlling grades DF and FG.

	Elev.	Station	Elev. Difference	Corrected for Atm. Pr.	Distance	Effect. Grade	Max. Vel.	Diff. Max. v	Correction Factor	Max. Diff. in v	Air Space Increase
D	1910	489									
			60	60	1800	.0333	13.3	18.8	1.20	22.6	54.3
F	1850	507									
			110	97.5	500	.1950	32.1				
G	1740	521									

It will be noted that in changing elevation difference in FG from 110 to 97.5 correction was made for difference in air pressure at the ends of the water column. The entire distance being but 500 ft. it is well however to ascertain the effect of the lowering of the water surface in FG at the end of 8 sec. The difference of entrance and exit velocity grew from 0 to 22.6 ft. in 8 sec. Placing the average difference at $\frac{2}{3} \times 22.6$ or 15.1 ft. the distance for which the pipe was emptied is 121 ft., the distance remaining full is 379 ft., and the elevation difference is $\frac{379}{500} \times 110 = 83.4$ ft. Correcting this for air pressure difference to 83.4 — 12.5 = 70.9 ft., the effective grade at the end of 8 sec. is $\frac{70.9}{379} = 0.1871$ as compared with 0.1950 as previously found.

The maximum velocity with such grade is 31.5 ft., the maximum inflow velocity is, as before, 13.3 ft., and the difference is 18.2 as compared with 18.8 and the resulting rate of air space increase is 52.5 cu.ft. per sec. against 54.3, or about 3 per cent less than that found before. In such a case it is evident that correction is unnecessary.

Finally conditions at point K (Fig. 1) may be studied with break upstream at J and consequent water movement away from K in both directions. The controlling grades are KJ and KL (or the working hydraulic grade). If we assume the next high point near the hydraulic grade to be a half mile or more away, the movement of water from K to the right will continue for some time at the previous rate or say 6 ft. per sec. without material deceleration. The controlling grade in the upstream direction is KJ and formula (6) instead of (5) applies.

	Elev.	Sta.	Elev. Diff.	Corrected for Atm. Pr.	Dist.	Effec. Grade	Max. Vel.	Sum Max. Velocities	Air Space Increase
J	1860	551							
			90	77.5	900	.0861	21.4		
K	1900	560						27.4	66.0
L							6.0		

From curves Fig. 2 it will be found that for a grade 0.0861 the maximum velocity will be practically reached in about 16 sec. During this period section KJ will have emptied for an approximate distance $21.4 \times \frac{2}{3} \times 16$ or 228 ft., leaving 672 ft. of pipe filled with total drop towards J of $\frac{672}{900} \times 90$ or 67.2 ft. Correction for air pressure difference makes the new effective grade $\frac{67.2 - 12.5}{672} = 0.0814$ corresponding to a maximum velocity of 20.8 ft. The sum of maximum velocities is now 20.8 + 6.0 = 26.8 ft. instead of 27.4, requiring a correction of 2 per cent which can be disregarded. There are special cases, however, of short grades when the correction becomes material.

One element has been left out of consideration, namely, the need of correction for initial velocity of flowing water. Such velocity is generally small compared with accelerated velocities near a pipe break. Its effect upon the method of determination is that the time required to reach higher velocity may have been over or underestimated by an amount generally not exceeding 1½ sec. The time factor enters only in the pipe emptying correction and as this correction is usually negligible initial velocity which at best is uncertain may be generally disregarded.

At first sight the application of this study may seem tedious and complex. It will be found, however, that by properly systematizing and columnizing the work it becomes surprisingly easy and simple.

Inlet Valve Capacity—The last step in this study is the determination of air inlet valve capacity under a given air pressure difference. The movement of air may be expressed by the simplified Clark formula (see Kent, 1923 ed., p. 664):

$$V = 352\,C\sqrt{1 + 0.00203\,(t - 32)\,\frac{h}{p}}$$

in which V is the velocity of free air in feet per second, t is the temperature of free air in degrees Fahrenheit, h is the height in inches of the water column measuring the difference in pressure, and p is the atmospheric pressure of the localitiy in mercury inches.

The values of the coefficient C found by Weisbach are:

For conoidal mouthpiece of form of the contracted vein with pressures of from 0.23 to 1.1 atmospheres	0.97 to 0.99
Circular orifices in thin plate	0.56 to 0.79
Short cylindrical mouthpieces	0.81 to 0.84
Short cylindrical mouthpieces rounded at the inner end	0.92 to 0.93
Conical converging mouthpieces	0.90 to 0.99

Air inlet valves consist usually of vertical check valves, the movable part being either a flat metal disk

with conical seating surface or a hollow cylinder. In either case the air rushing through the circular valve opening is deflected after entering by the valve itself and usually reconcentrated in a gate controlled passage connecting the valve with the pipe. The retarding effect of these curving air passages is unknown and leaves the selection of a value of C very uncertain. Until better information is at hand a value for C of 0.55 will

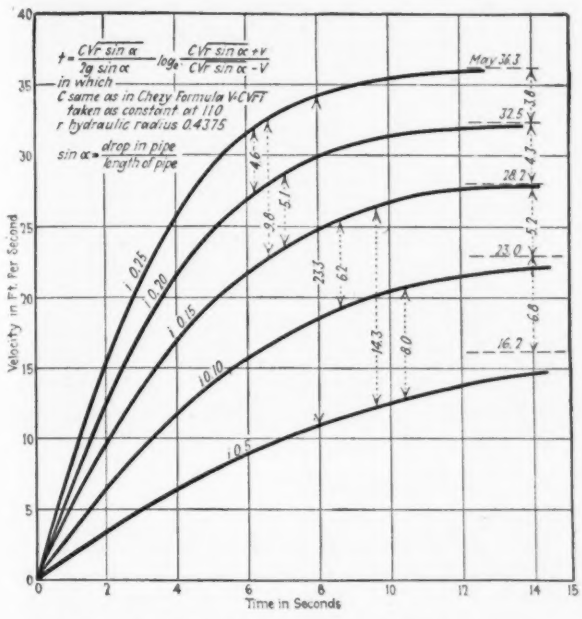

t = CVr sin α / 2g sin α log e CVr sin α + V / CVr sin α - V
in which
C same as in Chezy Formula V=CVrI
taken as constant at 110
r hydraulic radius 0.4375
sin α = drop in pipe / length of pipe
May 36.3
32.5
28.2
23.0
16.2
i 0.25
i 0.20
i 0.15
i 0.10
i 0.5
Velocity in Ft. Per Second
Time in Seconds

FIG. 2—RELATIONS OF VELOCITY AND TIME IN 21-IN. PIPE LINE

be assumed. Taking p at 27.8 for El. 2,000 ft. and outside air temperature under unfavorable conditions at 100 deg. Fahr., $v = 71.1C\sqrt{h}$. If, as in previous examples, the permissible air pressure drop be taken at 0.4 atmosphere, $h = 0.4 \times 27.8 \times$ (spec. grav. of mercury) $13.58 = 151$; and, introducing 0.55 as the value for C, $v = 481$ ft. applicable to free air.

The air expands upon reduction of pressure so that 481 cu.ft. open air volume would measure $\frac{481}{1-0.4}$ or 802 cu.ft. inside the pipe. Expansion causes cooling according to the formula $P_2/P_1 = (T_2/T_1)^{3.46}$ by which the temperature of the air under the conditions named is found to drop from 100 to 23 deg. Fahr. Contact with the pipe walls will, however, mitigate the extent of this cooling, and assuming the buried pipe just previously to air entrance to have carried cold water at 40 deg., the reduction of air volume by cooling may be based on a drop of temperature from 100 deg. to between 23 and 40 deg. or say 32 deg., causing a reduction of $\frac{32+460}{100+460}$ or 0.88. Thus the 802 cu.ft. of attenuated air will upon cooling occupy a space of 802 × 0.88 or 706 cu.ft. as against a volume of 481 cu.ft. of free air. So far therefore as volume of space in the pipe, occupied by air at 0.6 atmospheric pressure, is concerned, it may be found by assuming the velocity of entrance at 706 ft. per sec. On this basis the volume of air entering various sizes of air inlet valves per second as measured on the inside of the pipe is found as follows:

Diameter, in.	Area, Sq.Ft.	Inside Air Space Cu.Ft. per Sec.
2	.022	15
3	.049	34
4	.087	61
6	.196	138
8	.349	246

It now merely remains to compare the maximum rate of air space increase at air inlet points with the capacity of air valves to determine the size or combination of sizes which will be required. For convenience in application and for the purpose of indicating the effect of different assumptions as to permissible pressure reduction on valve capacity, the method explained above has been used to estimate this capacity, as measured in air volume within the pipe, for various atmospheric pressure differences:

Pressure Difference in Atmospheres	Diameter of Valve in Inches				
	2	3	4	6	8
	Cu.Ft. of Air Space per Sec.				
0.2	8	19	34	76	135
0.3	12	27	46	105	186
0.4	15	34	61	138	246
0.6	27	60	106	239	426
0.8	53	117	209	471	838

The solution herein offered has present value in that, after fundamental assumptions have once been made, it yields relatively consistent results. It is hoped that it may have value also in stimulating research in pipe shell strength and in flow capacity of various types of air inlet valves. As previously pointed out, individual pipe sections under ordinary conditions of backfill can be readily tested in the field. If information thus gained is published a fund of knowledge will gradually accumulate. The coefficient of air flow through air inlet valves is easily ascertained in the physical laboratory and besides giving much-needed information experiments would probably also lead to improvement in design by demonstrating the great advantage of smooth flow line passages.

How Typhoid Was Cut Down at East Liverpool

A water purification plant completed but poorly operated for a time greatly reduced typhoid fever in East Liverpool, Ohio. As operating conditions improved typhoid was further reduced until in 1925 there was not a single death from that disease in the city. The following details are extracted from a short article in a recent issue of *Ohio Health News*, the official publication of the Ohio State Health Department. The water supply of East Liverpool is obtained from the Ohio river 44 miles below Pittsburgh. During the four years preceding the completion of the water treatment plant in 1918, the average typhoid death rate was over 75 per 100,000. During the next four years the plant was operated under the direction of a part-time consulting analyst, and the average typhoid rate for the period fell to about 38 per 100,000. During the three years ending with 1925, the plant has been under the direction of a full-time chemist-in-charge, D. H. Rupp. Only two deaths have occurred in the period: One each in 1923 and 1924 and none in 1925. The typhoid death rate for 1921 was 55.3; for 1922, 18.2; for 1923, 4.5; for 1924, 4.4; for 1925, 0. The services of the full-time chemist-in-charge began September, 1922. The population of East Liverpool in 1920 was 21,411; for 1925 it is estimated as 22,900.

New Activated-Sludge Plant of Essen, Germany

Submerged Paddles Supplemented by Compressed Air from Diffuser Plates Produce Activation at 8 Hp. per M.G.

By Dr. Karl Imhoff
Chief Engineer of the Ruhrverband, Essen, Germany

Translated from the German
By Gordon M. Fair
Assistant Professor of Sanitary Engineering, Harvard University, Cambridge, Mass.

THE Ruhrverband has added an activated-sludge plant to the Imhoff tanks which since 1912 have treated the sewage of that part of Essen, Germany, which drains into the Ruhr River. The degree of purification demanded is particularly high, because the river is used as a source of water supply and because the municipal bathing beach is situated immediately below the outfall of the sewage into the stream. Construction of the activated-sludge plant was begun in May, 1925. The plant has been in operation since December, 1925;

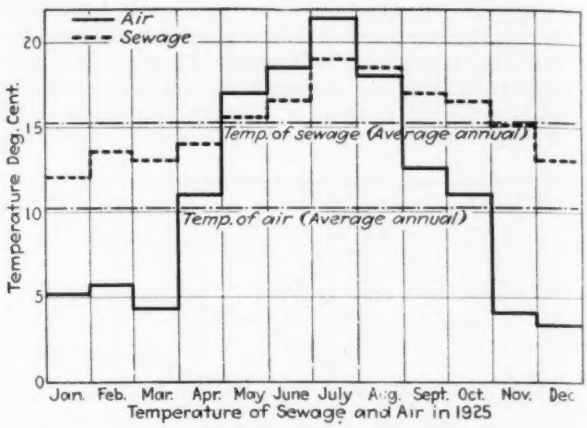


FIG. 2—TEMPERATURE OF SEWAGE AND AIR AT ESSEN IN 1925

The sewage, preheated in the Imhoff tanks, passes into long aeration tanks, then flows through final sedimentation tanks to the Ruhr River. The returned sludge is

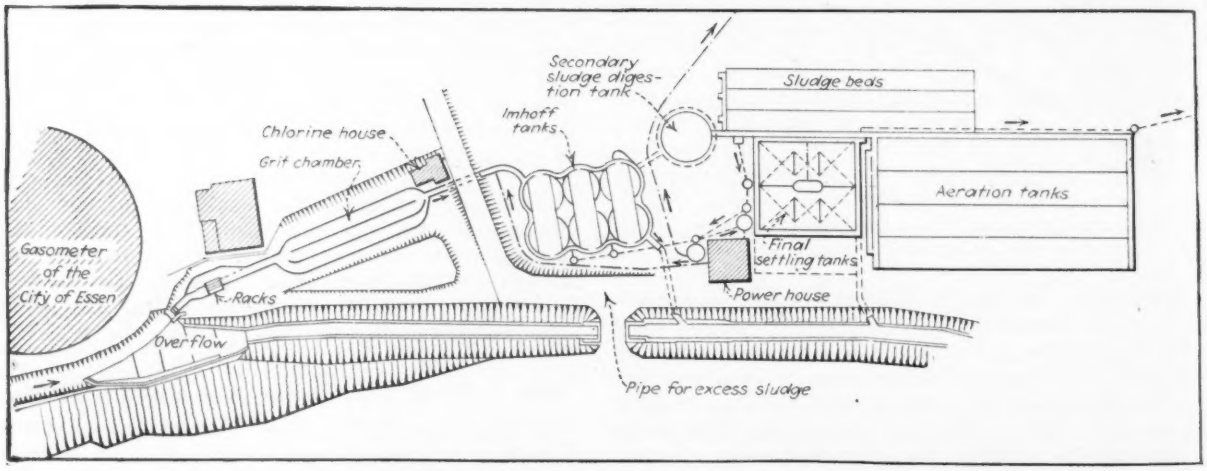


FIG. 1—LAYOUT OF IMHOFF TANKS AND ACTIVATED-SLUDGE PLANT FOR PORT OF ESSEN, GERMANY
The chlorine house is no longer in use but is kept in operating condition to meet possible emergencies.

about 45,000 inhabitants are connected. The dry-weather flow amounts to 5.8 m.g.d., corresponding to 130 gal. per capita. The volume of sewage is large, because the sewage proper is diluted by ground water and coal mine drainage rich in sulphur.

Coarse racks, a shallow grit chamber (Fig. 1) and six Imhoff tanks in existence since 1912 serve for preliminary clarification. The Imhoff tanks (described in *Engineering News-Record* Sept. 27, 1923, p. 512, in connection with the utilization of their gases) became much too small, the detention period having been reduced to but 20 minutes, and the sludge chamber capacity below the slot to 0.73 cu.ft. per capita. An elevated secondary digestion tank is used to further condition the sludge. This holds 0.36 cu.ft. per capita. In spite of their small capacity the digestion of the sludge in the Imhoff tanks is good, because the temperature of the sewage, which determines that of the sludge, is quite high (Fig. 2). The mean annual temperature is 15 deg. C. The value of the secondary digestion tank, however, is relatively small because its temperature is dependent upon that of the air, which averages 5 deg. C. lower and in winter even 10 deg. lower than the temperature of the sewage.

pumped back regularly from the final settling tanks to the aeration tank influent.

The four activation tanks re each 10 ft. deep and

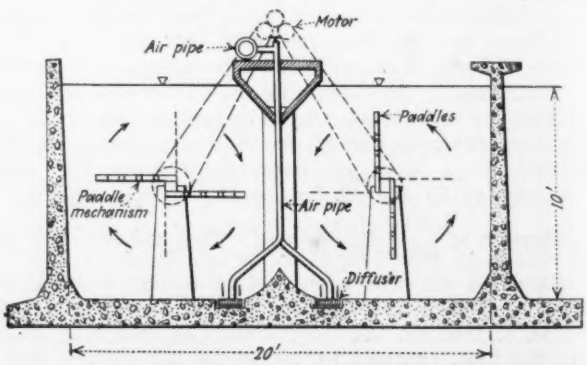


FIG. 3—SEWAGE AERATION TANK, ESSEN
The two rows of submerged paddles and two rows of supplementary air-diffuser plates divide the tank into two operating sections. Main reliance for activation is placed on the paddles, but the air-feed pipes and the two air compressors are large enough to produce activation without using the paddles. Movement of air bubbles from the diffuser plates is opposed by the paddle action thus detaining the bubbles and increasing the air efficiency.

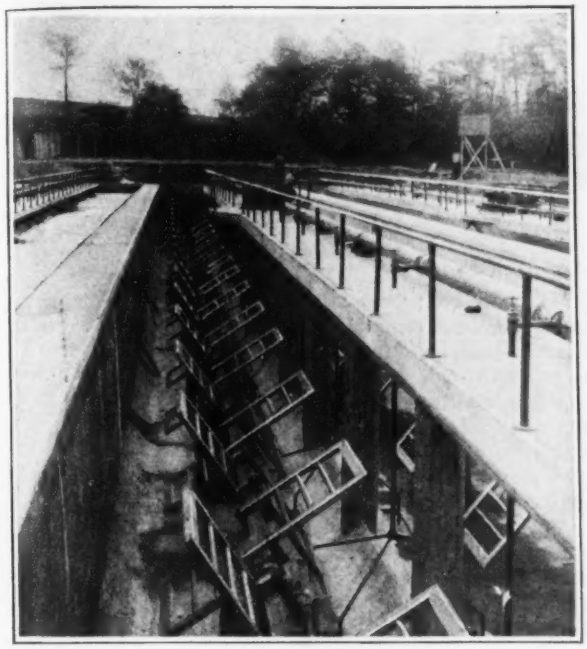


FIG. 4—SUBMERGED PADDLES IN ACTIVATION TANK

20 ft. wide (Figs. 4 to 5). When in operation each tank is composed of two sections, each 10 ft. in width, as will appear later. The dividing wall between the two sections is omitted, thus reducing the wetted perimeter and corresponding friction, since one side wall falls away in each tank. The sewage is forced to take a spiral path through the tanks. As distinguished from Indianapolis and Manchester, overturning of the sewage

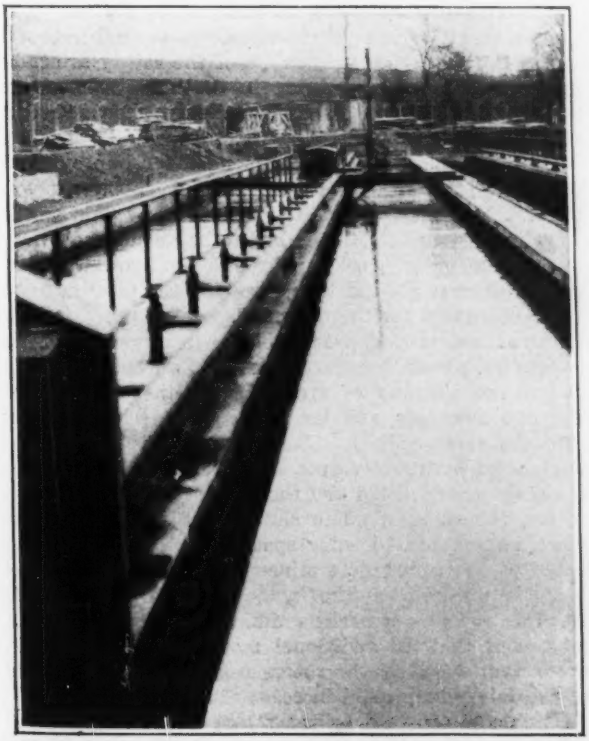


FIG. 5—ESSEN ACTIVATION TANK IN OPERATION

is produced not by compressed air but by two rows of wooden paddles operating on horizontal axes (Fig. 4). The oxygen required by the activated microörganisms is thus taken up at the water surface. To intensify aeration, however, a small amount of supplementary air is blown in from the bottom through diffuser plates. In order to secure the best possible use of this supplementary air supply, the two rows of plates are so located that the vertical rising of the air bubbles is opposed by the movement of the water induced by the paddles. By this means the air bubbles are forced to remain under water for a longer time. It was found that from the air thus blown in 30 per cent of the oxygen was consumed by biochemical activity. For comparative purposes we determined that in tanks operated with compressed air alone, according to the Indianapolis system, only 8 per cent of the oxygen of the air bubbles is utilized.

The two rows of diffuser plates are arranged one each side of the center line between the two tank

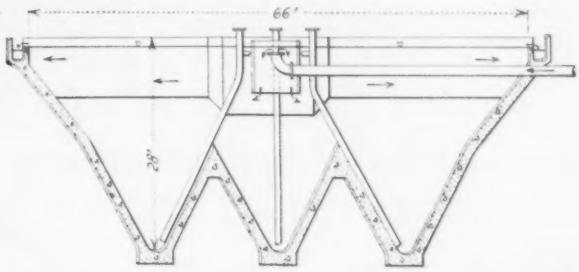


FIG. 6—SECTION THROUGH FINAL SETTLING TANK

sections. The air pipes are so dimensioned that the different tanks can be operated also by compressed air alone. Comparisons of the compressed air process alone and the combination of stirring and supplementary air have shown that the compressed air process demands the use of 0.7 to 1 cu.ft. of compressed air per galloh of sewage, while with the paddles only 0.14 cu.ft. are required. A total power consumption of 22 hp. per m.g. is registered in case of the compressed air process as against 8 hp. when the stirring mechanism and supplementary air are used. The capacity of the activation tanks corresponds to a detention period of 3½ hours for a mean dry-weather flow of 5.8 m.g.d. with 15 per cent of returned sludge.

The final settling tanks (Fig. 6) are funnel shaped, as is the custom in England. According to our experience deep tanks with as much vertical flow as possible are better for flocculent sludge (such as activated sludge) than shallow tanks. In the case of flocculent sludge the retention period is the controlling factor in calculating the size. This amounts to one hour, in the provision of which, however, the hopper volume occupied by the sludge must not be included. The sludge flows from the hoppers through pipes to a central well from which it is lifted by centrifugal pumps to the influent of the activation tanks. The lift is 3 ft. and the power consumption of the pumps is 2.5 horsepower.

The excess sludge is lifted to the influent to the Imhoff tanks (*Engineering News-Record*, June 4, 1925, p. 936). So far the excess sludge has been digested without difficulty in these tanks, also the raw sludge.

The cost of construction exclusive of the Imhoff tanks which were available from former years was $75,000.

Snow Removal on Mountain Pass Highways

Rocky Mountain and Coast Range States Have Real Excavation Problem in Hard-Packed Snow Drifts—Rotary Plows, Tractors, Power Shovels and Dynamite Called Into Service

By N. A. Bowers
Associate Editor, *Engineering News-Record*, San Francisco, Calif.

AND

C. H. Vivian
Boulder, Colorado

A SPECIAL problem in snow removal is presented by the mountain pass highways of the West. No attempt is made generally to keep these roads open in the depths of winter. Free to accumulate and to drift, snow covers the roadways in places to great depths. Left to disappear by melting, the roads would not be clear until long into warm weather. With approaching spring and the cessation of heavy snowfall, therefore, steps are taken to clear the way. This is a task of heavy drift removal and requires equipment and methods which are but infrequently necessary in the East where roads are kept continuously open and snow removal is a progressive operation. The two articles following give examples of mountain practice.

Snoqualmie Pass Highway in Washington

Ice in Side Ditches and Snow Weighing 40 lb. per Cubic Foot Increase Difficulties — Rotary and V-Plows Used

By N. A. Bowers

THE Sunset Highway, which is the main automobile route between eastern and western Washington, crosses the Cascade Mountains through Snoqualmie Pass at El. 3,010 in a region where the snowfall is heavy. The road has a gravel surface with several switchbacks and ruling grades of 5 per cent. It is not considered feasible to keep the pass open to winter travel and hence heavy, well-compacted snow has to be removed every spring from 10 or 12 miles in order to open the road within a reasonable time after other roads of the vicinity are in service. Snowfall in the pass is 25 to 30 ft. and by the time the road is opened in the spring this has compacted to perhaps one-third the original depth and weighs 35 to 40 lb. per cu.ft. Two factors that have complicated the clearing problem are the soft subgrade and frequent chunks of ice in the snow, such as would be caused by the freezing of water in ditches. For some years it was the custom to contract the work of removal, the prices varying from $5,000 to $7,500 for the eight miles of heaviest snowfall. For the last two winters, however, the highway commission has done the work itself. Observations and conclusions based on five years' experience in clearing the pass are summarized in the following.

At first the work was done with a steam shovel, using a special 3-cu.yd. bucket. This was slow and cost about 6.5c. per cu.yd. Several types of both rotary and V-plows have been tried and the department has concluded that the rotary plow is best. All equipment is required to be of much heavier construction than, and of a design somewhat different from, that suitable for comparatively soft and light newly fallen snow.

Last year the department tried out a specially designed push-plow weighing eight tons and operated by two 10-ton caterpillars working in tandem. This plow, which will be used again this year where the snow depth does not exceed 5 ft., costs $4,100 and last year operated over a 21-mile length of highway, clearing it to a width of 8 ft., with 16-ft. widths on turnouts at short intervals. The average cost for this work was $170 per mile. This included labor, $1,853; equipment and repairs, $1,538; gasoline and oil, $171; total, $4,564. The plow was not effective in heavy snow if the depth exceeded 5 feet.

The most successful plow used last year is a double rotary with a single main shaft drive from the engine of a 10-ton 45-hp. caterpillar, on which the plow is mounted. This plow has a cutting width of 10 ft., a height of 6 ft. and weighs 2½ tons. The frame supporting the rotors and the plow proper is mounted directly on the caterpillar frame with steel channels and heavy push bars. The rotors, placed one on each side of the plow proper and rotating in planes parallel to the center line of the road, are 5 ft. in diameter and have a normal speed of 250 r.p.m. In addition to its ability to handle deeper and heavier snow, the rotary has the further advantages over the V-plow for work through the pass that (1) it is cheaper to operate, (2) it can throw on either side, thus reducing the amount of hand shoveling and (3) it leaves the subgrade unharmed as it has no tendency to dig in.

As a result of last year's experience several improvements in the driving mechanism of the rotary are to be made. The angles of swing in the universals of the original plow for example, were only about 10 deg. Heavier universals and a swing to about 35 deg. are included in the changes recommended for improvement of the design. In operating in the deeper snow it was at first thought possible to gain time by taking the snow off in two lifts. This had to be abandoned owing to the caterpillar breaking through the snow with one or the other truck and thus throwing the plow into too much of a twist for the universals to take up.

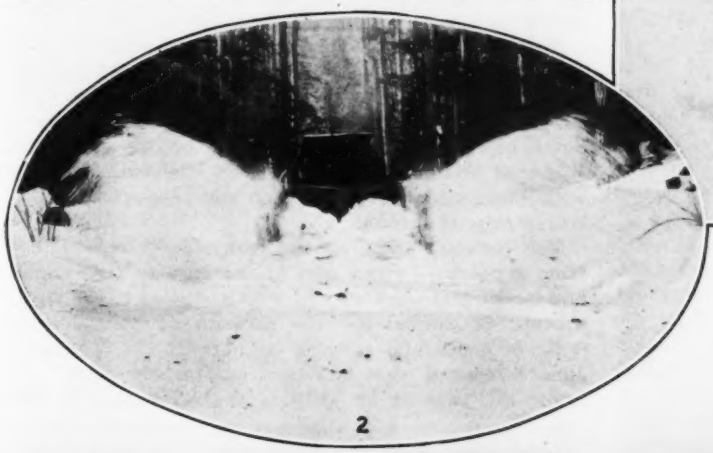
It has not proved practicable to use one caterpillar as motive power for the blades and another to push, due to the difficulty of synchronizing the operation of the two machines and the tendency to buckle or dig into the soft roadbed. The difficulty with using one engine for both motive power and rotors is that when the plow moves ahead and the heavy load comes on the motor, the rotors tend to slow down just at the time when an accelerated rotor speed is needed. Since the speed of the rotors determines the angle at which the snow is piled up on the inside edge of the cut, this slowing down is a serious difficulty. It is therefore suggested that an additional motor unit to maintain a constant speed of the rotors regardless of the speed of the caterpillar would increase the plow's efficiency.

The snow removed by the rotary in a distance of 8 miles, including the heaviest snow banks, cost $1,515 or an average of 1½c. per cu.yd. for the 98,000 cu.yd.

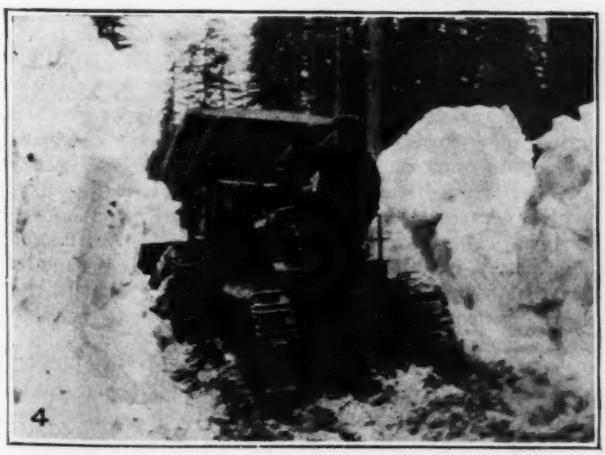
The average for the total 118,187 cu.yd. of snow removed from the highway last winter by this plow was 1.74c. per cubic yard.

In depths of snow exceeding 5 ft. where the snow has become extremely solid, the rotary cannot advance continuously but moves ahead a few feet until the snow

Clearing the Snow from Snoqualmie Pass in Washington



1—ROTARY OPERATING IN 2½-FT. SNOW
The low angularity of snow thrown at slow rotor speed gives satisfactory clearance at this depth.
2—ROTARY OPERATING IN 5-FT. SNOW
High rotor speed gives a steep angle to snow thrown out of cut.
3—ROAD EAST OF SNOQUALMIE PASS CLEARED BY PUSH PLOW
Curvature and soft roadbed make it difficult to keep two coupled tractors in alignment.
4—TWO CATERPILLARS BEHIND PUSH PLOW
5—PUSH-PLOW USED EAST OF PASS



In snow 2½ ft. deep, 4½ miles of roadway were cleared for a width of 14 ft. in 8 hours. In 6-ft. snow, a 10-ft. roadway was cleared for approximately 1,000 ft. in the same time. Progress varied greatly with the weight and condition of the snow. Considerable time was lost due to breakages and delays in making repairs. banks up too high in front of it, whereupon it is necessary for men with shovels to cut the banks to a slight angle, allowing the snow to be thrown up this angle from the tops of the rotors and clear of the edges of the cut. In widening the first cut through heavy snow it is usually possible to take out only about 12 in.

at a cut although it is believed that in freshly fallen snow it would be possible to take off as much as 3 ft. in width.

Clearing snow from Snoqualmie Pass is under the general direction of J. W. Hoover, state highway engineer, Olympia, Wash.

Fall River Pass Highway in Colorado

Side-Hill Slides Which Run In as Fast as Cut Through Complicate Work—Dynamite and Steam Shovels Employed

By C. H. Vivian

REMOVAL of snow from Fall River road, Rocky Mountain National Park, Colorado, each spring to enable traffic to cross the divide with the opening of the park on June 15 presents an annual highway operation of interest. Not only is this the highest pass road in any of the national parks, but it crosses the Continental Divide in an area which is subject to great snowfall and follows an alignment which is decidedly more favorable for drift accumulations than numerous other roads in the same state which attain greater altitudes. This year (1926) the problem was rendered more interesting than usual for several reasons. The winter's snowfall was considerably above normal, necessitating the handling of a greater yardage of compacted material. New methods were employed, inasmuch as it was the first year in which chief reliance was placed on steam shovel work. Another factor which appeared in greater degree than ordinarily was the occurrence of numerous slides which complicated the work during its earlier stages.

Fall River road is the major highway in the park. It extends 40 miles, connecting the eastern entrance, Estes Park village, with the western entrance, Grand Lake. The pass proper is at an altitude of 11,797 ft. and at a distance of 17.8 miles from Estes Park village. Ordinarily 15 miles of road must be cleared. Or rather, the clearing operations extend over that length, for there are places where the wind sweeps exposed portions bare. This year, because of last winter's abnormal precipitation, an additional mile was affected, while throughout the course the drifts were uniformly larger and deeper than usual.

The total snow removed was 119,359 cu.yd. and the average cost was 5.7c. a yard. Of the total, 78,386 cu.yd. were moved on the eastern slope operations, extending over 7.6 miles and 40,973 cu.yd. were moved on the western slope, where the operations extended over 8.2 miles. All of the western slope yardage and 7,758 cu.yd. on the eastern side were hand shoveled, the cost running 10c. a yard. The remainder, 40,973 cu.yd., all on the east face of the divide, was handled by steam shovel at a cost of 2.55c. a yard. It would appear at first glance that the steam shovel has an economic ratio of four to one, but this is not strictly true for the reason that the shovel must clear to a width of 15 ft. to operate, while in hand shoveling the drifts are trenched to a width of but 7 ft. Thus the shovel must handle a little more than twice as much yardage to clear a given length of road. However, this is not a disadvantage, as it gives the sun a better chance to complete the work and affords better drainage.

Operations were begun simultaneously at the base of the pass on both sides, May 15 being the starting date, as in past years. The western slope work was in charge of Ralph McQueary, one of the builders of the road and a veteran in snow removal work. He had a crew of 25 hand shovelers and a number of teams. They succeeded in working their way to the summit of the pass by June 8, when they turned about, widening out the roadway as they went back down.

On the east side hand shoveling was employed from milepost 10.2 to milepost 14.7, at which latter point the steam shovel had been left the previous fall. The shovel could not be utilized until the road had been cleared to it, as it had been decided to change the grates from oil-burning to coal burning.

It was on this lower stretch of hand shoveling that the trouble from slides was experienced. There were three slides and one of them ran eleven times, necessitating clearing the road anew each time. The lowest of the three slides ran a greater volume of snow than in any of the five preceding years since the road was completed. This slide started at the crest of Mount Chapin, 12,458 ft. high. Gathering volume from the snow that had accumulated in the gulch, it roared down the mountain side, sliding more than 2,000 ft. vertically. When it reached the road, it spread out fan-like and covered 410 ft. of highway with a jumbled mass of snow, rocks and trees to a depth ranging from 5 to 25 feet.

Using post-hole augers, holes were bored in the mass down to road level. Each of these was loaded with 25 to 50 lb. of dynamite, which was tamped with snow. The charges were detonated with a battery, about a dozen holes being fired at a time. In this manner, a V-shaped trough was cut through the slide and men with shovels completed a trench wide enough to enable trucks to pass through.

The heaviest snow on the east side is encountered from a point 3½ miles east of the pass to the summit and it was this segment which was allotted to the steam shovel. It worked its way through drifts averaging 6 ft. in depth and ranging as high as 20 ft. and on June 4 reached what is known as "the big drift" just below the pass at an altitude of 11,750 ft. At this point the prevailing westerly winds each year create a great snow cornice, portions of which never disappear during the hottest summer. The road is each spring covered for a distance of 1,500 ft., and it is this drift which occasions the biggest single operation on the project. This year the lower 200 ft. of the drift averaged 24 ft. in thickness, while the remaining 1,300 ft. measured 20 ft. The shovel made its way through this blockade in 9 days, sounding its whistle at the summit at 2 o'clock on the afternoon of June 13.

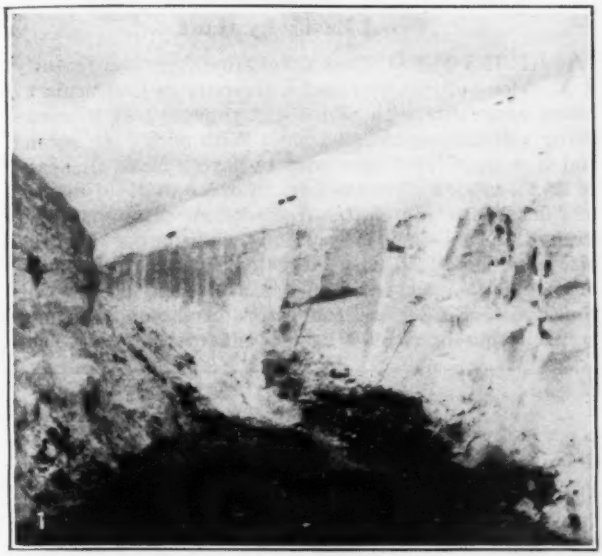
OPERATING EXPENSE OF SHOVEL ON FALL RIVER

Coal	$30.00	Two teams	$8.50
Operator	7.00	Two laborers	8.00
Fireman	5.50	One cook	3.20
Two teamsters	9.50	Incidentals	3.30

The shovel used was a 20-B Bucyrus equipped with special high lift and a special snow dipper of 1½ cu.yd. capacity. With its boom construction, it was possible to dump at an elevation 21 ft. above the roadway. Even this range was insufficient in the deepest portion of the drift, however. Accordingly, the shovel was run into the drift on wooden mats laid 5 ft. above the roadbed on the cushion of snow. These mats were constructed from three layers of 3x12-in. planks and were designed for the purpose by Roger W. Toll, superintendent of

Rocky Mountain National Park. They worked satisfactorily, the remaining 5 ft. of snow being removed by hand shoveling.

Snow Removal at Fall River Pass in Colorado

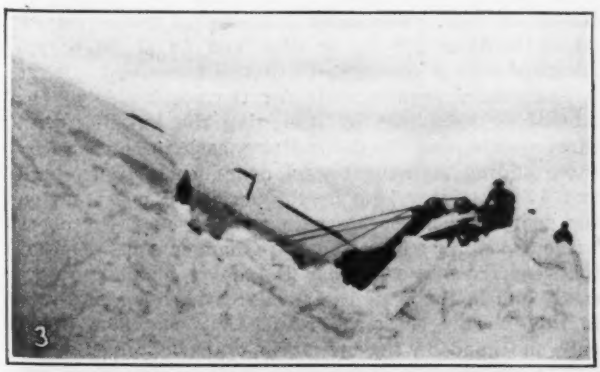


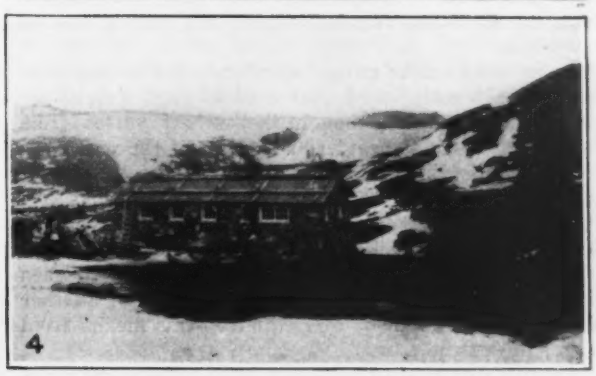
1—CUT THROUGH BIG DRIFT, FALL RIVER PASS
Shovel is around the turn out of sight. View shows where shovel was run into drift on plank mats 5 ft. above the ground.

2—SNOW SLIDE FROM MT. CHAPIN TO FALL RIVER PASS ROAD
View from near timberline on opposite side of canyon. There is more than 2,000 ft. difference in elevation between top and bottom of slide.

3—SHOVEL IN 20-FT. DRIFT AT TOP OF PASS
This is known as the "big drift" which occurs every year. This year it was 24 ft. deep for 200 ft. and 20 ft. deep for 1,300 ft. and took the power shovel nine days to cut through.

4—SHELTER AND BUNK HOUSE, FALL RIVER PASS
Here at El. 11,500 is housed snow removal crew. House contains eight double bunks, kitchen and dining quarters.





The operating expenses of the shovel during the 24 days it worked were approximately $75 a day, itemized in the accompanying table.

Coal worth $4.50 a ton at the mines in the valley 60 miles away cost $20 a ton delivered to the job. From Lyons, the nearest railroad point, it was trucked to Estes Park village and thence up the pass. It was piled at convenient points and delivered directly to the shovel by teams.

Working a shift which varied from 8 to 10 hours a day, the shovel handled from 2,000 to 4,000 cu.yd. of

snow daily, the average being 2,940 cu.yd. Figuring the average dipper load as 1.33 cu.yd., this meant that 3.6 swings per minute were made on the basis of a 10-hr. day and 4.6 swings per minute on a basis of an 8-hr. day, or a probable average of four swings.

No stakes were set on top of the snow and the operator had to feel his way with the crawlers. He also made sure of his path at intervals by sounding the snow at the outside edge of the roadway. As the highway is constructed almost entirely on steep sidehill sections, deviation from the proper course would have caused difficulties. While the mats were being used traction was obtained by studding the crawler plates with heavy bolts.

The work of clearing the road each year is directly in charge of Superintendent Toll of the park. The cost, which this year was $6,800, or $425 a mile, is borne by the National Park Service and the transportation company which has the exclusive privilege for maintaining passenger bus carriers within the park. If it were possible to leave all the work until the day before the road was to be opened and concentrate a large enough force to effect the clearance, natural melting would by that time so greatly reduce the amount of snow that the task would be materially lighter. A melting chart compiled each year under the direction of Superintendent Toll shows that from May 15 to June 15 the drifts decrease an average of 3.6 in. a day. On days of bright sunshine as much as 6 in. sometimes melts. A drift on which accurate records were kept diminished from 13 ft. in depth to 2 ft. in the space of 37 days.

This year McQueary's crew on the western side pitched its camp at Poudre Lakes, 4.7 miles west of the pass, on May 26. It had to shovel away 5 ft. of snow to effect a clearance. At the time the road was opened, 20 days later, the ground at the camp site was bare.

Last year dynamite was used in the big drift near the summit, the roadway having been mined with 650 lb. of 20-per cent gelatin base powder for the distance of 300 ft. as an experiment. While considerable of the snow was thus removed, that which remained was compressed into ice, rendering it extremely hard to handle. This year less dynamite was used than ever before, none at all being required where the shovel was in operation.

After lying on the ground all winter, the drifted snow is so highly compressed that a cubic yard weighs approximately 380 lb., though the weight varies from lighter at the top to heavier at the base of the accumulation. If this figure, 380 lb., is used, the total weight of the snow handled becomes roughly 22,500 tons.

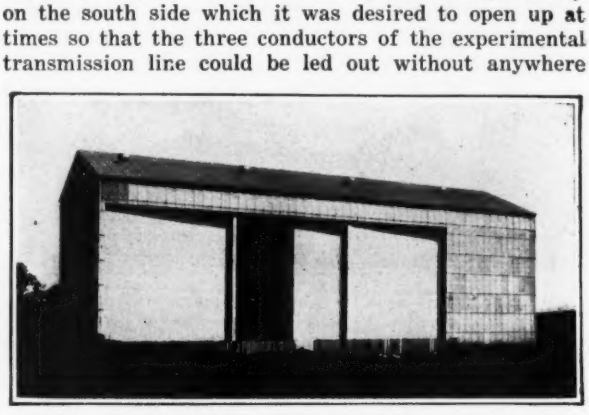
The steam shovel having proved both practical and economical, it is probable that it will be used in increasing degree in future years. It is likely that when the park appropriation permits the purchase of another shovel, the work will be carried on by this means from both sides of the pass.

Accommodations for workmen were greatly improved this year by the construction in the fall of 1925 of a shelter house of rustic stone a short distance east of the pass. This housed the steam shovel crew and insured them comfort. In past years all workmen had to eat and sleep in tents and great trouble was experienced from the high winds which occur at intervals every spring.

Large Sliding Doors Designed for Easy Operation

Three 44 x 47-Ft. Steel Doors on New Electrical Laboratory at Stanford University are Moved Easily by Hand

A HIGH-VOLTAGE electrical laboratory has recently been built at Stanford University in California to house apparatus with which experiments will be made using voltages up to 2,000,000. With such high potential it is considered necessary to have a clear air space of 20 ft. around all conductors in order to avoid danger of "flashovers" or electrical discharge through air to ground. This imposed special conditions as to the size and height of the laboratory structure, notably on the south side which it was desired to open up at times so that the three conductors of the experimental transmission line could be led out without anywhere



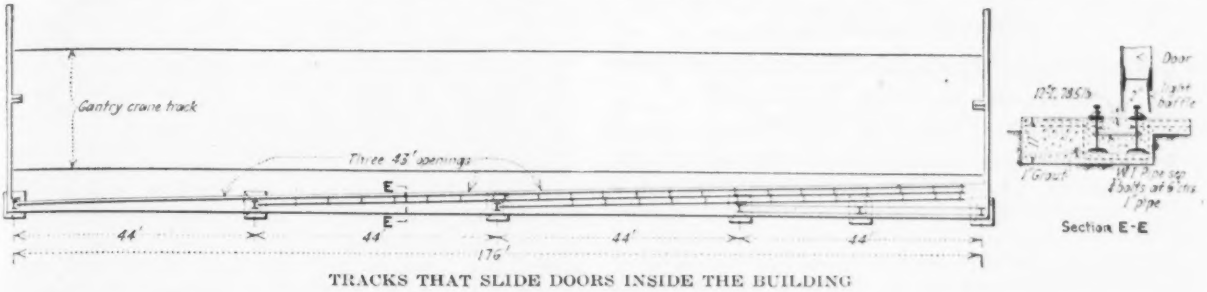
SOUTH SIDE OF RYAN HIGH-VOLTAGE LABORATORY
Middle door partly open.

coming within 20 ft. of each other or the frame of the building. The building frame is considered to be grounded.

The three conductors that require the 40-ft. openings during test can be disconnected within the laboratory when not in use and attached to outside hooks provided for that purpose at the ends of the roof trusses, thus making it possible to close the large openings. The trusses are designed to take the pull due to dead and wind load on these cables. Corrugated iron is used on the doors only. The sides and roof of the structure, which is 84 x 176 ft. in plan and 68 ft. high, are sheathed with a corrugated asbestos compound.

The special requirements for the south side of the laboratory were met by designing the building with three openings of the desired size, each to be closed by three sliding structural steel doors, each 47 ft. high and 44 ft. wide. This height permitted operators on the floor of the laboratory to walk through the doors without coming within the 20-ft. danger zone. One of the requirements was that the doors should operate easily and in the design particular attention was given to this feature with the result that one man, using only one hand on the operating crank, can easily roll one of the doors a distance of 44 ft. in less than one minute or, one man can move all three doors to the extreme end of their tracks, thus opening all doors completely, in 10 minutes.

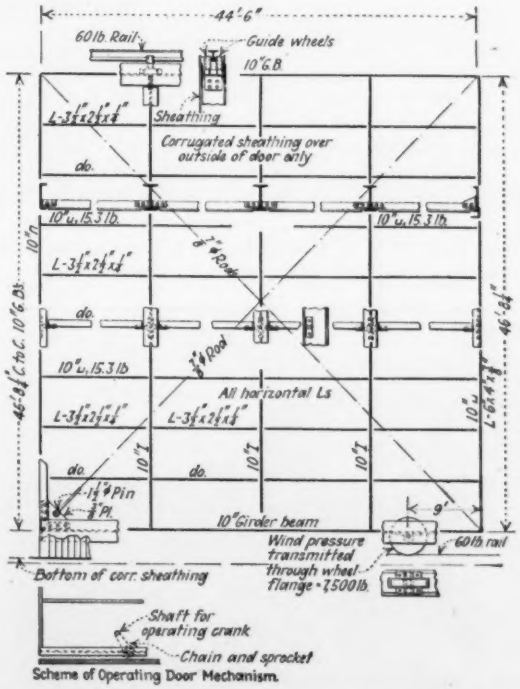
The doors are built up of structural steel as shown in the accompanying drawing, stiffened by two diagonal tie rods. The steel frame is covered with galvanized iron roofings. Each door weighs 16,000 lb. and this



TRACKS THAT SLIDE DOORS INSIDE THE BUILDING

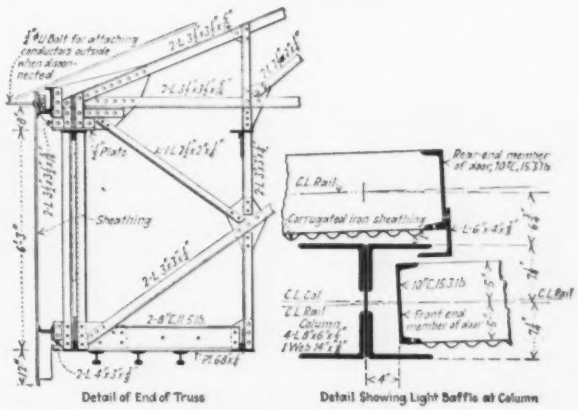
weight is carried on two wheels which are spaced so as to keep at a minimum the bending moment in the bottom member. Slots were cut for these wheels in the web of the girder beam which constitutes the bottom member of the door. The rails on which the wheels operate are bolted to steel beams embedded in concrete and great care was taken in placing the rails to get them exactly level.

At the top, the doors are kept in a vertical plane by rollers or guide bearings on vertical shafts which move along the sides of rails bolted to supports above. These bearings take their share of the wind pressure on the doors which is figured at 15 lb. per sq. ft. The top guides as well as the wheels that carry the weight of the doors operate in roller bearings. The rails at the top are bolted to what is virtually a horizontal girder with the web—a ¼-in. plate—on the under side and flanges with web stiffening above. This girder transfers any wind thrust from the doors into the roof truss.



ELEVATION SHOWING STRUCTURAL DETAILS OF DOORS

One of the requirements for these doors was that they should be light tight so that the laboratory might be made dark for photographing electrical discharges. To meet this requirement use was made of the principle of the labyrinth light baffle, such as that used in the photographer's dark room. This design is effective in keeping out light and has the advantage that there are no curtains or flexible materials to wear out. The baffle at the forward end of each door was made by using a much deeper recess in the door post than would otherwise have been used and that at the rear end by a projecting flange, as shown in the drawing. The same



GIRDER AND COLUMN DETAILS

Section through horizontal girder above doors including end of roof truss, and detail showing light baffle at column.

general scheme was used at the top and bottom of the doors by means of plates on both sides of the steel frame which project as far beyond the wheels as safe clearance will permit.

Operation of the doors is effected by a chain-and-sprocket operated by a hand crank on the rear wheel. The rear wheel on each door has a spur gear engaging a link belt roller chain connecting with a smaller sprocket at a level convenient for hand operation. The crank is removed when not in use so as to permit the doors to slide close to one another. To prevent impact of a moving door against its post crane stops are fastened to each rail at a point that will stop the door before it actually strikes the post.

Structural details of the laboratory were prepared under the direction of C. H. Snyder, consulting structural engineer, San Francisco.

Tourist Railway in European Caves

In Italy, at the village of Postumia near Trieste, there was recently put into operation an odd underground narrow-gage railway to enable tourists to visit the famous ancient grottoes which abound around the new railway. The train consists of a miniature locomotive with small cars capable of carrying 200 tourists at a time, and eight trains are run daily.

Four-Track Diversion Built by Pennsylvania R.R.

Eliminates Heavy-Traffic Line Through Town—New Bridge Has Gantleted Tracks—Old Bridge Utilized for Highway

A 3½-MILE loop or diversion around the town of New Brighton, Pa., involving grade separation and a long bridge across Beaver River, is a costly work completed recently by the Pennsylvania R.R. This improvement will give the railroad better facilities for its heavy traffic and will relieve the town from a busy main-line railroad which now traverses the entire length of one of its principal streets, and has a dozen grade crossings of intersecting streets. The town, with a population of 10,000, is 26 miles from Pittsburgh and within the residential suburban zone.

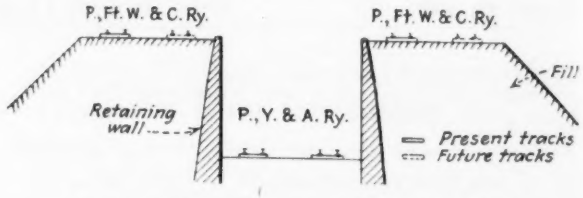


FIG. 2—GRADE SEPARATION AT JUNCTION

River on a skew, with a double-track bridge of steel deck spans. Provision is made for a second parallel double-track structure, but, in view of the high cost, both the substructure and superstructure of the present bridge are for two gantleted tracks. Five of the spans are trusses varying in length from 116 to 222 ft.; the others are girder spans. All spans have a concrete slab deck and stone ballasted tracks.

The new bridge crosses a highway and electric railway toll bridge owned by a local traction company. It was necessary, therefore, to wreck one span of the

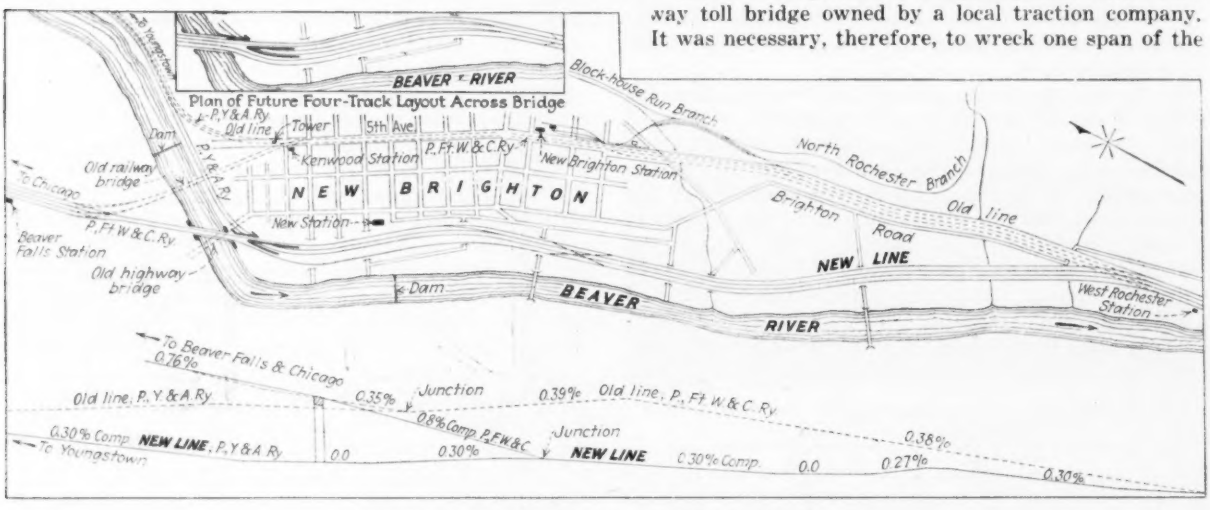


FIG. 1—OLD AND NEW LINES AT NEW BRIGHTON, PA.

Both east and west of this town the railroad has four tracks, but there was no room for additional tracks along the street. On the other hand, the municipal authorities have for some years been urging the removal of the present tracks as the railway traffic through New Brighton averages 90 passenger trains and 70 freight trains daily. Therefore the railway has built a new line around the town and along the bank of Beaver River, extending from West Rochester to Beaver Falls. This new line has four tracks, with a double-track gantlet across the Beaver River. The distance and grades remain about the same, although the introduction of a fly-over junction increases the present maximum grade of 0.76 per cent to 0.8 per cent. The line is almost entirely on a fill made with slag from steel plants in the Pittsburgh district, and the embankment is held at some points by concrete retaining walls to prevent encroachment upon streets and the river.

Subways are provided for streets extending to the river bank and to reach a river-front park. This work has necessitated relocation of streets and changes in street grades, with repaving and the relocation of sewers, water mains, and other public utilities. Some of these subways are of reinforced-concrete and others have solid-floor steel spans on concrete abutments.

At the north end, the diversion line crosses Beaver

latter structure, so that the toll bridge becomes useless and will be removed. To overcome this difficulty, the Pennsylvania R.R. will sell its old bridge to the county authorities, and will build a new concrete deck with

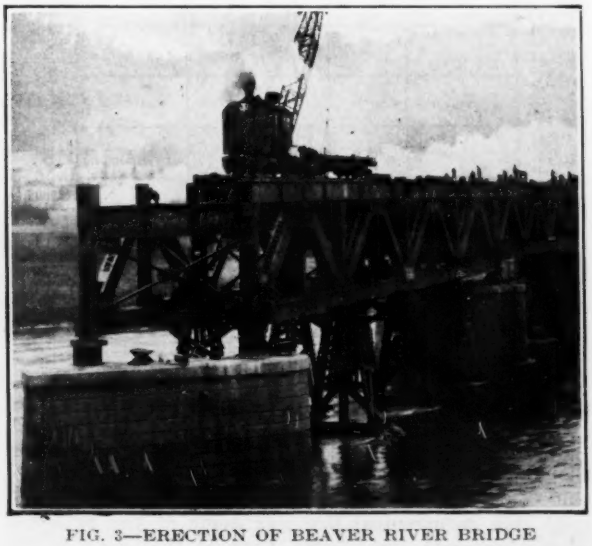


FIG. 3—ERECTION OF BEAVER RIVER BRIDGE

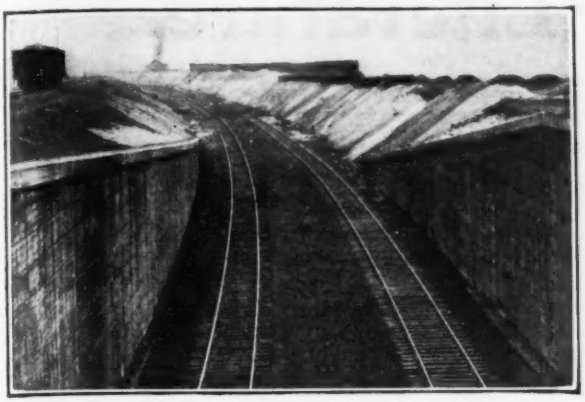


FIG. 4—FLY-OVER JUNCTION ON FOUR-TRACK LINE
Main tracks on either side rise from junction; track at left then crosses over branch line.

roadway and sidewalks; it will be operated without tolls.

Fig. 5 shows the old toll bridge with one span removed to make way for the new railroad bridge. Beyond the latter is the old railroad bridge, which will be converted to highway purposes. The tracks in the foreground, passing under the bridge, are those of the Pittsburgh & Lake Erie R.R., at the left; the Pittsburgh, Youngstown & Ashtabula R.R. (Pennsylvania System) is along the opposite bank of the river.

Still another complication was introduced by the fact that the double-track line of the P., Y. & A. R.R. diverges from the main line at New Brighton. This branch, which is used for freight only, has a heavy coal and ore traffic, carrying 30 of the 70 freight trains passing daily through this town. In the old arrangement the connection was a simple double-track junction, as shown by dotted lines in Fig. 1. On the new diversion, however, it was necessary to provide a fly-over junction, keeping the branch tracks clear of the main-line tracks. This condition is met by spreading the main tracks sufficiently for a depressed double-track line between them, the main tracks being carried up on a grade of 0.8 per cent to allow the others to pass under them with a full headroom of 22 ft.

From the cross-section, Fig. 2, it will be seen that there is the curious combination of a double-track cut with retaining walls along the middle of a wide fill. At present there is one main track on each side of the cut, but later there will be two tracks.

Two old stations in New Brighton are replaced by a larger station with more central location. A minor difficulty encountered was that the new bridge interfered with the Pittsburgh & Lake Erie R.R. along the north bank, Fig. 5, making it necessary to shift the tracks and to move the brick station from the east to the west side of the bridge. For this latter change, the building had to be moved first down the river bank to the water's edge so as to pass under the old bridge, after which it was moved up the bank again to its new position. At the south end of New Brighton, one of the original main tracks will be retained as a spur to serve local industries and to connect with the Blockhouse Run and North Rochester branches, both of which are single-track lines operated for freight business only.

This diversion line, with its bridges and other works complete, represents a total cost of about $6,700,000. It was planned and built under the direction of Robert Trimble, assistant chief engineer, Pennsylvania R.R., with the construction in charge of L. J. Riegler, assistant engineer. The general contractors were W. F. Trimble & Sons, Pittsburgh, Pa. The superstructure of the Beaver River bridge was built by the Mount Vernon Bridge Co., Mount Vernon, Ohio, and the substructure by the Dravo Contracting Co., Pittsburgh, Pa.

Old Track P.Y. & A.Ry.
Old Railroad Bridge (Future Highway)
New Tracks of P.Y. & A.Ry.
Old Line, Pa. R.R.
New Railroad Bridge, Pa.R.R.
P.L.E. & W.Ry.
Old Toll Bridge to be removed

FIG. 5—REVISION OF PENNSYLVANIA R.R. AT NEW BRIGHTON, PA.

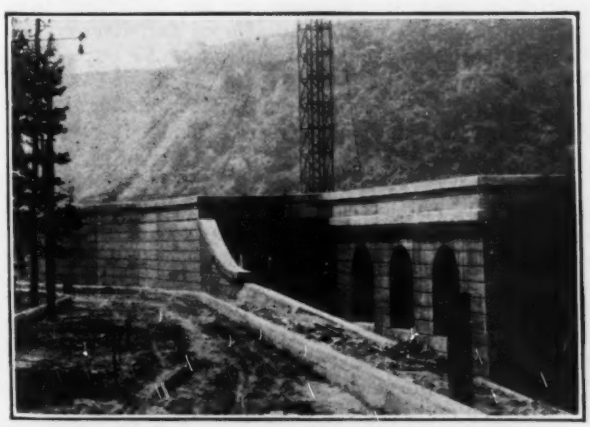


FIG. 6—SKEW BRIDGE CARRIES MAIN LINE OVER BRANCH

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Another Good Handbook

REVIEWED BY G. N. LAMB

District Engineer, Division of Highways, Illinois Department of Public Works and Buildings, Elgin, Ill.

HIGHWAY CURVES AND EARTHWORK—By Thomas S. Hickerson, M. Am. Soc. C. E., Professor of Civil Engineering in the University of North Carolina. New York: McGraw-Hill Book Co., Inc. Flexible; 5 x 7 in.; pp. 381, including nearly 200 pp. of tables; line cuts. $3.50.

Engineers' "handbooks" have appeared in such numbers in recent years that one wonders whether there is still room for a volume original and distinctive in character. Yet Mr. Hickerson ventures into an overcrowded field to present in concise and convenient form just the information needed by the busy engineer who has been assigned the problems incident to the making of surveys and the preparation of plans for the public highway to meet the conditions of modern traffic.

After a brief chapter embracing the general consideration of highway location, the author covers the subjects of circular and spiral curves, banking and widening the roadway on curves, and the measurements and computations of earthwork.

The chapter on highway location reviews preferred current practice and recognizes the contribution to standardization for which we are all indebted to the U. S. Bureau of Public Roads. A fund of practical information and instruction is contained within the forty-five pages devoted to location. The reconnoissance, preliminary and location surveys, as well as data to be secured on surveys, and the form of notes are set forth in a way that will apply to metropolitan areas as well as to strictly rural conditions. It is to be regretted, however, that the subject of the proper appearance of a road has not received more thorough discussion; for while a road pleasing in appearance may be unnoticed by the great majority, an unwise or unstudied alignment or grade line, or a combination of both, may produce an effect exceedingly ugly in appearance and outstandingly noticeable to countless travelers. These displeasing effects may be largely obviated by the properly trained and painstaking engineer. More specific instructions or a few "don'ts" would have made a valuable contribution toward a better appreciation among engineers as to what constitutes esthetics in highway location and design.

The author defines "degree of curve" as the angle at the center subtended by an *arc* of 100 ft. On this definition he bases his curve formulas, which are adequately explained by examples and supported by original tables for both circular and spiral curves having external deflection angles extending to 140 degrees.

A new feature presented is an explanation, with tables, of a method of laying out curves by deflections from the P. I. With points of equal division along the curve the deflections are independent of radius or length of curve. This method should prove to be a convenience as well as a time saver. It will save "set-ups."

The book tells how to use a vertical curve having a flatter or steeper profile than the ordinary parabola. The use of such curves may facilitate the reduction of grading quantities or the betterment of sight distance.

A total of 73 pp. of text and 61 pp. of tables is devoted to spiraling, banking and widening of curves. All the refinements required by modern practice are made clear. Especially valuable are the tables for determining the areas of widened pavements. The adjustment and care of instruments is covered concisely though thoroughly. The author has deemed it worth while to devote space to discussion and to tables pertaining to the determination of the true meridian, reference to which should be in much more common practice in highway surveys.

Mr. Hickerson's book should occupy as prominent a place among highway engineers of today as did the one by Searles among railroad engineers a generation ago.

German Text on Multiple Arch Dams

REVIEWED BY FRED A. NOETZLI

Consulting Hydraulic Engineer, Los Angeles, Calif.

DIE STAUMAUERN: THEORIE UND WIRTSCHAFTLICHSTE BEMESSUNG, mit besonderer Berücksichtigung der Eisenbetontalsperren und Beschreibung ausgeführter Bauwerke—Von Dr. Ing. N. Kelen. Berlin: Julius Springer. Cloth; 8 x 11 in; pp. 294; 307 halftones and line cuts. 39 reichmarks, in Germany.

A large number of dams of the arch and multiple-arch type have been built in the United States and many more in foreign countries. Some of these dams were designed by rather crude methods. The subject of a scientific design of dams of these types has been studied by many engineers in this country and abroad. Much progress in this direction was made in recent years.

The treatise listed above is an especially valuable addition to the literature on dams. Keeping in line with the modern tendencies of concrete dam construction, the author concentrated his efforts entirely on dams of the lighter than gravity type. Regarding gravity dams, he refers the reader to the well-known books on dams by Wegmann and others.

The design of deck slabs of the Ambursen type is first taken up. A comprehensive analysis is then given of arches subjected to water load. In the third and fourth chapters the stresses in the buttresses are analyzed, and formulas are developed for determining the most economical size and spacing of the buttresses. The rest of the book is devoted to details of construction and to the description of a considerable number of deck-slab, arch and multple-arch dams in Europe, America and elsewhere.

Of particular interest are the author's formulas for the design of circular arches, and the numerous tables and curves, which will be of much help to the practical designer. Noteworthy, also, is the clear and precise analysis of stresses in the buttresses. The author has developed from elementary principles the theory of the principal stresses in a buttress of triangular shape. He shows that the ideas of many engineers as to the importance of the shear stresses in horizontal planes are based on an erroneous assumption.

Common Honesty and the Golden Rule

THE ETHICS OF BUSINESS: A Study of Current Standards—By Edgar L. Heermance. New York and London: Harper & Brothers. Cloth; 5x8 in.; pp. 244. $2.

Those who read this book in a spirit of detachment from business activity will hardly know whether to be more surprised at recent progress in the formulation and adoption of codes of business ethics and the high stand many of them take or at the fact that the fundamental basis of most of these codes is common honesty, chiefly of the 'best policy' sort. It is comforting to read that the dishonest—presumably of the grosser sort—are estimated at only 5 per cent of those engaged in some of the great classes of industry.

The author states in his Preface: "The book is really the outcome of my own search for an inductive approach to Social Ethics." In that search the author has collected and studied some 300 codes of business and professional ethics (chiefly the former) and carried on much personal correspondence. The diversity of the organizations having codes of ethics is striking. To name them would be to catalog many of the chief industries of the country—baking, cold storage, hay, ice cream, knit goods, monuments, machine tools, slate, varnishes, to name but a few.

Since the codes under discussion are largely the work of trade organizations, the first chapter of the book is on The American Trade Association. The next one is on Codes of Business Ethics. These two chapters make a good introduction. Part II, Present-Day Standards, takes up competition, good-will, advertising and better business, outdoor advertising, commercial honesty, credits and contracts, professional ethics, business as a public service, fair profit, and the employee. Part III, Business Ethics and Social Science, deals with motive and custom, ethics as a science and Christianity and business.

As the author points out, many of the codes of ethics are composed largely of platitudes. This is particularly true of those parts of codes which deal with common honesty or restate the golden rule. Less platitudinous but perhaps more self-deceitful if not hypocritical are some of the declarations setting up "service" or "public service" as the primary object of an entire industry or class of business; for, put baldly, all industry and business is either service or swindle. "Service" has been obfuscated by trying to carry over into business the idea of professional service and by attempting to distinguish between the intangible and the tangible, or between service and commodity. Moreover, any kind of business so widespread as to warrant a trade association and of a sort to need a code of ethics has profit as its primary object with service, however the word is used, as a means to that end—the better the service (or commodity) the larger and surer the profits. Obvious as this seems in the abstract its growing acceptance in the business world is a sign of progress. Credit for it is largely due to the growth of trade associations and also of the acceptance of co-operation in trade and industry.

Finally, Mr. Heermance's useful and stimulating book suggests that an effort might well be made to compress into a few simple and short sentences the ethical principles common to all codes, leaving to special sections such provisions as are called for by the divergent needs of different classes of business and industry.

New Textbook on Hydraulics

REVIEWED BY JOHN H. GREGORY
Consulting Engineer; Professor of Civil and Sanitary Engineering, Johns Hopkins University, Baltimore, Md.

HYDRAULICS—By Joseph N. Le Conte, Professor of Engineering Mechanics, University of California. New York and London: McGraw-Hill Book Co., Inc. Cloth, 6 x 9 in.; pp. 348; 191 line cuts. $3.

The theoretical principles of hydraulics are so presented in this book as to solve most problems by appeal to first principles. The book has been written primarily for the student and not for the practising engineer. Mechanics and pure mathematics, including differential equations, are freely used and the reader should have these at his command if he wishes to follow the text easily.

The book is divided into three parts; to hydrostatics the author devotes one chapter, to hydraulics eight chapters, and to hydraulic machinery six chapters. At the end of most of the chapters problems, with their answers, are given. All told there are 120 such problems. The text is well written, and the mathematical presentation excellent but sometimes a little difficult to follow as most of the symbols used are defined in a list at the front of the book, preceding the introduction. From some points of view there is much to be said for this arrangement but there are places in the text where some of these symbols could, to advantage, be defined again in order to assist the reader in following the author's treatment of his subject. For the student, however, studying the book from day to day, it is probable that he would soon become familiar with most of the symbols used. One of the admirable features of the book is the presentation of many special problems the solutions of which are ordinarily not found in treatises on hydraulics.

The student who has mastered the text should be well grounded in theoretical hydraulics, but when he comes to solve the everyday problems of most hydraulic engineers he will have to learn a new language as he will then have to refer to handbooks and practical treatises on hydraulics for coefficients and many formulas in common use. The author, however, recognizes such omission and calls attention to it in the preface. The practising engineer can well afford to add the book to his library for use when he has to go back to theoretical principles for the solution of some special problem.

Altogether, the book is a good one. It is well printed and bound and the cuts, in general, are well executed. In a second edition some of the plates might well be redrawn and some of the tables reset so that the reader or student would not be annoyed by having to turn the book around in following the text. An index is included.

A Comprehensive Survey

DISEASE PREVENTION—By Herbert H. Waite, M.D., Professor of Bacteriology and Pathology, University of Nebraska. New York: Thomas Y. Crowell Co. Cloth, 6x9 in.; pp. 667. $4.50 net; postage extra.

Dr. Waite's treatment of the very broad subject, Disease Prevention, is fresh, comprehensive and interesting. He states in his preface that the book "is a digest written especially for all those who have neither a medical nor an engineering background, and who would, therefore, have some difficulty in securing information from original sources." After a readable historical review of 56 pp., a shorter chapter on sanitary science and a few pages on epidemiology, there are a number of

chapters on the various means of disease transmission, followed by chapters on the prevention of the different classes of disease. In scope, the volume is similar to many preceding books on public health or preventive medicine. Where sanitary engineering is taken up a number of errors and misleading statements are made, but generally as regards practical details which the class of readers for whom the book is designed do not need to know and which do not affect fundamental principles. These could easily be rectified in a later edition.

The Framework for Ohio Land Titles

REVIEWED BY J. M. WEED

Instructor in Civil Engineering, Ohio State University, Columbus, Ohio

ORIGINAL OHIO LAND SUBDIVISIONS, Being Volume III, Final Report (In Four Volumes), Ohio Co-operative Topographic Survey—By C. E. Sherman, C. E. (Civil Engineering Department, Ohio States University), Inspector. Including large folding map of Ohio showing Original Land Subdivisions. Cloth; 6x9 in.; pp. 233; 40 maps and charts plus separate map as above. For sale by state geologist, Columbus, Ohio, $3 with large map dissected and mounted; $2, map unmounted.

"Ohio," as the author of this volume says, "is unique among States of the Union in the variety of its land subdivisions." They extend all the way from the crazy-quilt patchwork of the Virginia Military District to the ranges and townships of Northwestern Ohio which are referred in modern fashion to principal meridians and base lines. These various methods, confused by changes in policy and alteration in laws and instructions, are traced chronologically to cover the whole state in nine entertaining chapters. Conditions under which the lines were run, irregularities, definite descriptions of the books containing the original records—all are given. There is a chapter on the importance of original subdivisions, the framework on which all later surveys and descriptions depend. The present rectangular system is described, its advantages set forth, and its history traced back to its probable origin in Ancient Rome. The book contains much information on Ohio Lands, the treaties, laws and instructions under which the surveys were made. Finally our present public land survey system is reviewed. Numerous maps in the text and large folding maps in a pocket add to the interest and value of the volume. The book should interest not only abstracters and surveyors who are looking for specific information, but also engineers and even general readers, particularly those who are historically and philosophically inclined.

Lectures on Industrial Alloy Steels

THE METALLOGRAPHY OF STEEL AND CAST IRON—By W. E. Woodward, M.A., M. Iron & Steel Inst., Lecturer in Metallography at the Engineering Laboratory, Cambridge University. London: Crosby Lockwood & Co. Cloth; 7x9 in.; pp. 143; illustrated, 15s. net in England.

These lectures before students "who read the 'Chemistry of Engineering Materials' for the Mechanical Sciences Tripos" at Cambridge University, England, were designed "to present in a small compass the metallography of steels and cast iron, with particular reference to those alloys of steel which are of industrial importance." The five sections of the book deal with alloys of iron and carbon; thermal critical points in iron and steel; high-speed and other special steels—manganese, nickel, chromium, etc.; theories of hardening; pyrometry. There is a plentiful supply of graphs and photomicrographs.

An Enginer Is Hero of This Novel

JORGENSEN—By Tristam Tupper. Philadelphia: J. B. Lippincott & Co. Cloth; 5x7 in.; pp. 266. $2.

Rivalry between two railroads to reach a strategic point and the wrongful imprisonment of an engineer at the instance of the promoters of one of the lines afford the background for this story. After years in prison during which his mind becomes almost vacant the engineer escapes and as though by animal instinct finds his way to a tunnel which is being driven in resumption of work on his old railway line—and here the story begins. He becomes transitman on the tunnel at a time when the work has been going badly and gradually the engineering direction of the enterprise falls to him, but through an indirect channel that supplies one of the main currents of the story. The resident engineer comes to a tragic end and is succeeded by the hero, who in time becomes a victim of ill fate, but only for a short time. Two women add zest to the story.

Throughout, the mountain being pierced by the tunnel is personified as a force resisting man's attempts, while Jorgensen, the hero, is pictured as having almost uncanny powers of recognizing and thwarting nature's resistance to man's efforts. The story is interestingly told, but with a bit of clumsiness both in the narrative and in attempts at engineering detail. Fortunately the latter are few while the spirit of the engineer, of the construction gangs and of a major engineering operation permeates the entire story. Particularly notable is the way in which renewed contact with engineering work and with nature restores the broken spirit and almost lost mentality of the engineer after his long and unjust imprisonment. "Jorgensen" deserves a place on the shelf with a few other good stories with engineers as leading characters.

How to Use English

ENGLISH APPLIED IN TECHNICAL WRITING—By Clyde W. Park, Professor of English, College of Engineering and Commerce, University of Cincinnati. New York: F. S. Crofts & Co. Cloth; 6x8 in.; pp. 313; 8 graphs. $2.25.

Professor Park's book is frankly a text. A large part of it is pure grammar, some of it is concerned only with the mechanical part of writing, that is the size of paper, kind of ink, location of pages, numbering, etc., and part of it is what used to be taught under the head of rhetoric. Nevertheless, the grouping is such and the selection such that the whole constitutes an admirable general scheme of instruction to the engineer in the writing of English. The author, in common with a number of other professors of English in our technical schools, disclaims teaching engineering English. He is concerned entirely with teaching the engineer how to use English, an entirely different thing.

Teaching English necessarily involves much drudgery and any textbook on the teaching must portray that drudgery. This text does not avoid it more than do any others, but the author has an excellent English style of his own and when he gets away from those matters which imply drudgery, his style has a lightness that cannot but communicate itself to the student who is gleaning knowledge therefrom. Altogether, Professor Park has produced a book useful both to the student and to the engineer who realizes, a little late possibly, that his schooling lacks something in this sometimes disdained subject of conveying one's thoughts by the written word.

A New Transportation Literature

TRANSPORT AVIATION—By Archibald Black, Consulting Air Transport Engineer, formerly Consulting Engineer, U. S. Air Mail Service, Chairman (1925) Aeronautic Division, A.S.M.E.; M.A.S.M.E., M.Soc. Automotive Engrs.; M. National Aeronautic Assoc., M. National Aeronautical Safety Code Committee. New York: Simmons-Boardman Publishing Co. Cloth; 6x9 in.; pp. 245; 107 halftones and line cuts; 26 tables. $3.

In almost continuous succession books are published by various authorities on transportation by water, by rail, and latterly by motor highway. Now begins a new transportation literature—that of the air. This book, written by one of the first and most persevering of air travel exponents, gives the present status and points out the future possibilities of airplane passenger and freight traffic in the United States in a comprehensive manner. Necessarily, much of the treatment is based on predictions and assumptions, but the author has evidently endeavored to avoid statements not based upon existing experience or upon a logical assembly of known facts. Representing as it does the edited result of a number of articles written by the author and published in various technical magazines, it is not surprising that there is some repetition in the various chapters.

Straight exposition of generalities of air transport forms only a small portion of the total text. For the most part, the book considers specific problems that will have to be met by airplane designers, by the operating personnel, by the management, by financiers, and by engineers interested in the design, location and maintenance of landing fields. About 25 tables present data on transportation by air. In the appendix many operating statistics of the United States Air Mail Service are tabulated. Some typical chapter headings of special interest to civil engineers are: Factors Governing the Development of Air Routes, Design of Passenger Airplanes, Design of Freight and Mail Airplanes, Airways and Landing Fields, Landing Field and Maintenance Equipment, Air Transport Organization and Personnel, and Air Transport Investment and Operating Cost.

If the book is somewhat visionary, still it is approached in the logical manner for any new subject—with acknowledgment of shortcomings and an open mind for other viewpoints. The deduced conclusions arrived at seem logical. Whether they will map future developments can only be a matter of conjecture. The author's effort is worth-while if it starts organized thinking on the subject. The book is the beginning of a new literature.

Structural Design of Wood Buildings

ARCHITECTURAL CONSTRUCTION, Vol. II: AN ANALYSIS OF THE STRUCTURAL DESIGN OF AMERICAN BUILDINGS—By Walter C. Voss, S.B., consulting engineer, Boston, Mass., formerly head of Department of Architectural Construction, Wentworth Institute, Boston; and Edward A. Varney, S.B., structural engineer, Cambridge, Mass., formerly Instructor of Mechanics and Structural Design, Wentworth Institute, Boston. Book I, Wood Construction. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. Cloth; 9x12 in.; pp. 418; 203 halftones and line cuts. $6.50.

The first volume of this extensive series on Architectural Construction ran to 1,246 pp. and 358 plates with 581 figures in the text and bore a price of $20. It dealt with Analysis of Construction, largely in the form of examples of executed buildings by living architects. The second volume continues the analysis in five books, of which the present one, on Wood Construction, is the first. Of the four books to follow this one, there will be one each on steel and concrete, one on walls and foundations and one on the mechanics of structural design.

The present book is in five parts, dealing with the design of beams, floors, roofs and columns and miscellaneous framing. The treatment is descriptive and analytical, with problems, formulas, graphs, detail drawings and halftones. The views are primarily illustrative of the text rather than being mere pleasing pictures although some of them are that. Some show buildings under construction and others show floors under their actual working loads.

The book promises to be useful to the student and the working engineer and architect besides containing much of general interest.

Cement and Concrete

THE MAKING AND TESTING OF PORTLAND CEMENT AND CONCRETE—Wilmington, Hull, England: G. T. Earle, Ltd. Cloth; 6x9 in.; pp. 139; 56 halftones and line cuts. 10s. net.

The company which publishes this book has been in business since 1809 and as early as 1826 was manufacturing "Roman cement." The present head of the company is an Earle, descendant of the founder. All this shows that the firm is typically British, but it is also typical of the changing view toward business in Great Britain that this century-old company is alive enough to get out a book describing not only the details of the manufacture of portland cement as practised in its own plant, but also elaborating on the modern methods of making concrete. There is not much that is new in the Earle book, but it is complete and authentic. Certainly, it will be a valuable handbook for the British engineer as well as a testimonial to the appreciation of modern British industry that it knows that to have its product rightly used is one of the surest ways to increase the use of the product.

Materials and Parts Specifications

S.A.E. HANDBOOK, MARCH, 1926—Compiled and Published by Society of Automotive Engineers, 29 W. 39th St., New York City. Cloth; 4½x7½ in. $2.50 to members, $5 non-members.

With the publication of the Handbook of the Society of Automotive Engineers as a bound volume to be reprinted in revised form semi-annually, it becomes unnecessary for owners of the volume in its earlier form to insert superseding data sheets, and to check the collation periodically. The Handbook gives the sources of supply of parts and materials fabricated according to S.A.E. specifications, which now number somewhat over 600. In addition to sections on nomenclature, tests, index, city regulations, etc., the book is divided into twelve sections dealing with the standards and recommended practices for power plants, lighting, electrical equipment, parts and fittings, iron and steel, non-ferrous metals, non-metallic materials, transmission, axles and wheels, tires and rims, frames and springs, and controls.

For Reference, Brushing Up or Study

MATHEMATICS FOR ENGINEERS—By Raymond W. Dull, Consulting Engineer, M.Am.Soc.M.E., M. Western Soc. Engrs. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 780; 686 line cuts. $5.

From the sections on brain saving methods in simple addition through the whole 57 chapters to the end of the one on partial and multiple integration the author seems to have kept well in mind his object of producing a book "primarily for engineers," including those "who want a quick and convenient reference," whose mathematics has become "somewhat rusty" and those who

"feel the need of a text for the study of mathematics." The book is a revision and enlargement of notes made for the personal use of the author. Graphical methods are extensively shown.

PUBLICATIONS RECEIVED

A SUMMARY OF state and national forestry activities in pamphlet form may be obtained from the American Tree Association, 1214 Sixteenth St., N. W., Washington, D. C.

AN INSTRUCTIVE PAPER on Extensions of Water Mains, by W. C. Hawley, chief engineer, Pennsylvania Water Co., Wilkinsburg, Pa., read recently before the Pennsylvania Water Works Association, is now available in pamphlet form.

THE VARIOUS ACTIVITIES for Der Ruhrverband, a union for various purposes of the municipalities of the Essen industrial district, are described in a quarto pamphlet of 30 pp. by Dr.-Ing. Karl Imhoff of Essen, Germany, under date of June, 1926.

COMMERCE YEARBOOK, 1925, may now be had for $1 from Superintendent of Documents, Washington, D. C. It contains statistical and other information on foreign trade, fuel and power, construction industry and materials, machinery, and a variety of other subjects.

NEARLY A HUNDRED MILLION DOLLARS of fire loss is included in 19 conflagrations between May, 1901, and March 1, 1926, which are outlined in a prefix to a thin pamphlet, The Menace of the Wooden Shingle, published by the National Fire Protection Association, 40 Central St., Boston, Mass.

AMERICAN TRADE AND INDUSTRY is the title of a new fortnightly for the "promotion of trade between the U.S.S.R. (Russia) and the U.S.A., just issued in June by the Amtorg Trading Corporation, 165 Broadway, New York City. Except for the names and addresses of advertisers the Journal is printed in Russian.

PORT SERIES No. 17 deals with the Ports of the Territory of Hawaii. Like the other volumes in this admirable series, this one is prepared by the Board of Engineers for Rivers and Harbors, War Department, in co-operation with the U. S. Shipping Board. (40c., from Superintendent of Documents, Washington, D. C.)

PEAT FOR FUEL has been the subject of joint investigation by the governments of the Dominion of Canada and the Province of Ontario for some time past. A final report on the investigation by B. F. Hannel, honorary secretary and member, Peat Committee, has been issued as an illustrated volume of 298 pp. (Apply to Department of Mines, Ottawa.)

EMPHATICALLY YES is the answer to "Can We Compete Abroad?" a well-written bit of propaganda work by C. C. Martin, put out by the National Foreign Trade Council, India House, New York City. One of the most interesting chapters is entitled Our Pioneering Engineers, which like the rest of the book deals with achievements rather than theory.

A FAVORABLE REPORT on Concrete Exposed to Alkali in Los Angeles and Vicinity has been made by Salisbury, Bradshaw & Taylor, consulting engineers, Los Angeles, Calif. The investigation on which the report is based was financed by the Western Concrete Pipe Co., from whom (P. O. 355, Los Angeles) the report may be obtained on application.

THE ALWAYS INTERESTING SUBJECT, Colorado River silt, is treated in a 27-p. paper by J. F. Breaveale, research specialist in agricultural chemistry, published by the Arizona Agricultural Experiment Station. As would be expected from the official position held by the author, the study is largely chemical in character. (Address University of Arizona, University Station, Tucson.)

FURTHER STUDIES on the biology of sewage disposal, issued as the fourth annual report of the sewage substation (1924-25) of the New Jersey Agricultural Experiment Stations and the New Jersey State Department of Health, contain papers on Imhoff tanks, sprinkling filters, and related matters, by Willem Rudolfs, director, and others. (Address Sewage Substation, N. J. Agricultural Experiment Stations, New Brunswick, N. J.)

RECENT BULLETINS issued by the Engineering Experiment Station, Iowa State College, include one of 31 pp. on A Preliminary Experiment on the Supporting Strength of Culvert Pipe in an Actual Embankment, by M. G. Spangler, assistant engineer, as a part of co-operative work between the station and the U. S. Bureau of Public Roads; and a study of Bacteria in Creamery Wastes, by Max Levine, bacteriologist, and Lulu Soppeland, assistant. (Free, from Dircetor, Engineering Experiment Station, Ames, Iowa.)

IN COAL MINE EXPLOSIONS, coal dust is a very small factor, the main factors being gaseous conditions and insufficient ventilation, so that rock-dusting to counteract the presence of coal dust is of no effect in non-gaseous mines. These are the fundamental claims of a 190-p. book on "The Rock Dust Remedy for Coal Mine Explosions," by Harry Phythyon, state inspector of mines for the 27th bituminous district of Pennsylvania ($2 from the Belle Vernon Agency, Belle Vernon, Pa.)

THE AMERICAN MUNICIPAL ASSOCIATION, an organization of state and provincial (Canadian) associations generally known as municipal leagues, has issued a report of 162 closely printed pages consisting of the *Proceedings* of the two annual meetings (1924 and 1925) thus far held. Membership is open to "any state municipal organization" of ten active members whose dues are paid by a municipality. ($10 from John G. Stulz, executive secretary, The American Municipal Association, Lawrence, Kan.)

GEODETIC AND TOPOGRAPHIC SURVEYS of city areas are so few and far between as to make a pamphlet now to be had for the asking a welcome addition to the scanty literature of the subject. Reference is made to a paper on The Geodetic and Topographic Survey of Pittsburgh and Allegheny County, read last December before the Engineers' Society of Western Pennsylvania and since revised to March 23. The authors are U. N. Arthur, chief engineer, Department of City Planning, Pittsburgh, Pa., and R. H. Randall, engineer of survey of the same department and head of R. H. Randall & Co., geodetic and topographic engineers, Toledo, Ohio. The field work of the survey, which is being carried to an unusual degree of accuracy, has been completed for Pittsburgh, and is being extended over all Allegheny County. Reprints of the paper may be had without charge on application to either the City Planning Department of Pittsburgh or the Toledo company just named.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

DRUCKROHRLEITUNGEN — Von Dr.-Ing. Felix Bundschu, Oberingenieur im Ingenieurbüro und Dr.-Ing. Adolf Ludin, Berlin-Charlottenburg. Berlin: Julius Springer. Paper; 6 x 9 in.; pp. 60; illustrated. 6 reichmarks in Germany.

STEEL STRUCTURES: STRESSES IN SIMPLE STRUCTURES —By Leonard C. Urquhart Professor in charge of Structural Engineering, and Charles E. O'Rourke, assistant Professor of Structural Engineering, Cornell University. New York and London: McGraw-Hill Book Co., Inc. Cloth; 7x9 in.; pp. 278; line cuts. $3.50.

The fundamentals of stress calculations in simple structures are here taken up, the author says, "without complicating the discussion with frequent reference to the economics of design," the latter subject left for a companion volume. Both graphical and analytical methods are used.

STRUCTURAL STEEL SHAPES: Information and Tables for Engineers and Designers, and Other Data Pertaining to Structural Steel, Manufactured by Carnegie Steel Co. Pittsburgh: Carnegie Steel Co. Paper; 5x8 in.; pp. 195. With specifications, mathematical drawings, and tables.

The tables and other useful data given in this handy little volume relate to "structural sections considered most suitable for use in bridge and building construction." Safe loads for beams are tabulated for unit fiber stresses of 18,000 and 16,000 lb. per sq.in. Besides stresses a variety of other tabular matter is given.

VERANSCHLAGEN VON EISENBETONBAUTEN—Von Prof. Dr.-Ing. A. Kleinlogel, Privatdozent an der Technischen Hochschule, Darmstadt. Dritte, vellstandig neubearbeitete Auflage. Berlin: Wilhelm Ernst & Sohn. Paper; 6x9 in.; pp. 175; illustrated. 9 reichmarks in paper; 9.9, bound.

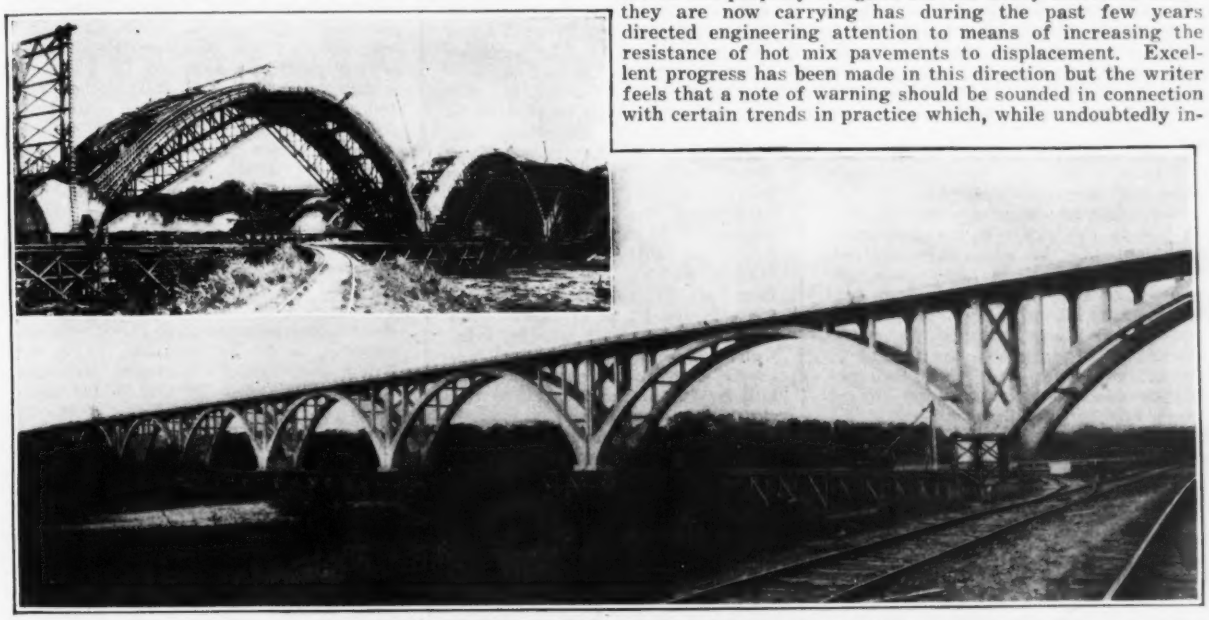
Letters to the Editor

A FORUM FOR DISCUSSION OF VIEWS OF ENGINEERS AND CONTRACTORS

Can Steel or Concrete Be Erected More Rapidly?

Sir—On a recent visit to New York the writer was impressed by the slow relative progress observed in the erection of structural frame buildings with concrete floors.

The lightness or seeming flimsiness of the construction compared to the less expensive and more substantial appearing concrete buildings of the West may be accounted for by the exuberant expectation that New York City structures may be torn down in a few years to make way for others twice as high—hence ease of destruction is more important than the aesthetic appearance, solidity and permanence and the highest resistance to damage by fire.



SNELLING-MENDOTA BRIDGE: TWO VIEWS A YEAR APART
Smaller view taken July 15, 1925; large view July 14, 1926, with work in progress on the eleventh arch. Spans are 304 ft.

As structural steel with its fireproofing seemed hopelessly outclassed in the short spans of building construction the writer became interested in comparing the erection progress on the longer spans used in bridge construction.

In erecting the Soo Line R.R. bridge over the St. Croix River about seven weeks was spent in putting up the end 350-ft. arches with full falsework, four weeks in erecting the second arch with half falsework, and 11 days in erecting the third or center arch, cantilevering from each end. Comparable concrete arch construction is shown by the two views herewith, showing the Snelling-Mendota bridge on July 15, 1925, and July 14, 1926, respectively. On the latter date the eleventh span was well under way; eight 304-ft. spans had been completed in twelve months, during which the work was shut down three months when it was too cold to work economically. As the work progressed the rapidity of erection increased to about twenty days for moving ahead one span.

Comparing this concrete arch construction with the steel truss highway spans over the Missouri River at Bismarck, the steel for the 485-ft. span was coupled up above the floor in three days' time, the floor steel and truss being placed in less than seven days. Nevertheless the time spent in constructing the falsework, riveting up the joints and casting the floor slab leaves the record at Bismarck short of the spiral flat-slab arches at Snelling.

Structural steel supports made possible the rapid erection at Snelling. The time of lowering the steel arch supports and shifting them forward for the 304-ft. arches was two and a half weeks for the first shift and seven days for the last—i. e., the shifting of the steel falsework at Snelling was accomplished in the same short time that the steel trusses at Bismarck were erected after placing falsework.

With increased duplication erection records may be lowered. In the proposed Oversea concrete bridge near Key West, 16 mi. long and 37 ft. wide, there will be 2,000 spiral flat-slab spans alike. A mile a month is the final expected progress after the full equipment is at the site.

With the rapid hardening of alumina cements and their increased strength the rapidity of concrete construction will in the future be greatly increased, together with the length of span attainable economically.

Minneapolis, Minn., July 14. C. A. P. TURNER, Consulting Engineer.

Avoid Too Stiff Mixtures For Asphalt Paving

Sir—The formation of waves in some of our asphalt pavements not properly designed for the heavy intensive traffic they are now carrying has during the past few years directed engineering attention to means of increasing the resistance of hot mix pavements to displacement. Excellent progress has been made in this direction but the writer feels that a note of warning should be sounded in connection with certain trends in practice which, while undoubtedly increasing stability, will if carried to extremes, result in the production of pavements which are more apt to crack in cold weather due to contraction.

It has been definitely established that increasing the percentage of filler, decreasing the percentage of asphalt and hardening the asphalt will produce a more stable pavement than has frequently been laid in past years but we have not as yet determined just how far we should proceed.

During the past two years the Asphalt Association has developed a test for measuring stability of fine aggregate asphalt paving mixtures but the evaluation of this test in terms of service results has not as yet been completed. The test shows the relative stabilizing effect of all of the factors above mentioned and indicates that increase in percentage of filler is perhaps the most effective. At the present time data are being assembled in connection with the stability of pavements of known history subjected to various climatic and traffic conditions and it is hoped that in the near future the influence of these factors will be properly evaluated both with relation to stability at high temperatures and resistance to cracking at low temperatures.

Until this work is further advanced the writer feels that it is particularly dangerous to proceed to extremes in hardening the asphalt cement or in greatly reducing its percentage in the paving mixture, as it is believed that longest serviceable life and greatest resistance to cracking will be obtained from mixtures carrying the largest percentage of a moderately soft asphalt which will produce the degree of stability required by the traffic and climate which it will have to meet.

New York, N. Y., July 6, 1926. THE ASPHALT ASSOCIATION, PREVOST HUBBARD, Chemical Engineer.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Arthur McMullen Dies From Traffic Accident Wounds

New York Contractor Fatally Injured on Leaving Engineers' Club—Pioneer in Subway Work

Arthur McMullen, president, Arthur McMullen Co., contractors, New York City, and for the past thirty-five years identified with many of the notable bridge, foundation and subway jobs in the east and middle west, was fatally injured Monday night, August 16, when struck by a taxicab at the corner of 40th Street and Fifth Ave., New York City. Mr. McMullen had just left the Engineers' Club, of which he had been a member for many years, when the accident occurred.

Following the accident, Mr. McMullen lay on the sidewalk for thirty-five minutes before an ambulance arrived, although both he and his friends are reported to have requested that a private car take him to the hospital. Someone applied a solution of ether and alcohol to the injured man's head to prevent suffering, and while the ambulance doctor was examining him, a match was lit to aid the surgeon. The flame ignited the solution and blazed around Mr. McMullen's head for several seconds before it could be extinguished. Friends were reported to have said that an inquiry into supposed negligence on the part of the authorities will be asked for. Mr. McMullen died in the hospital about three hours later. He was 72 years old.

Mr. McMullen was born in Canada, the son of a contractor, and started his contracting work in the west. He engaged in railroad construction for a time, coming to New York in 1893. His first contract in New York was the construction of the bridge over the Harlem River on Kingsbridge Road. The first pneumatic caisson work on building foundations was used by him on the Commercial Cable Building in New York City in 1905. Mr. McMullen was the only man to hold the distinction of having been a contractor on all three of New York's subways.

Among his other achievements was the recent construction of the pneumatic foundations of the new bridge of the Central Railroad of New Jersey across Newark Bay, and for the Castleton Cut-off bridge for the New York Central R.R. over the Hudson River south of Albany. The Pennsylvania R.R. bridge over the Susquehanna River at Havre de Grace, the bridge over the Delaware River near Trenton, the bridge over the Monongahela River at Pittsburgh for the Wabash R.R., and another over the Missouri River at Pierre, South Dakota, for the Chicago and Northwestern R.R., represent other important contracts that he executed.

At the time of his death Mr. McMullen was working on two contracts for New York City, the Roosevelt bridge over Flushing Creek and a portion of the Eighth Avenue-Washington Heights subway.

Engineering Fifty Years Ago

From *Engineering News*, Aug. 1876

The Hudson River Tunnel

ACTIVE preparations are now in progress for the construction of the Hudson River Tunnel on the Jersey shore. The entrance to the tunnel is located on Jersey Ave., near Fifteenth St., and the excavation will be carried in a northeasterly direction, terminating in Washington Square, New York. The tunnel will be two miles in length, and it is calculated the cars will pass through it in three minutes. The road bed will be twenty-three feet in width. The shaft at the foot of Fifteenth St., Jersey City, is 100 ft. in circumference and the brick wall is 3 ft. 4 in. thick. The shaft has been sunk to the depth of twenty feet, and will be further excavated to the depth of sixty-two feet, when the excavation beneath the river will be commenced. The machinery for the work is now in position, and it is stated that the excavation of the shaft will be completed within twenty days. The eastern grade of the tunnel is two in a hundred feet, descending from Jersey City, then ascending on the New York side two in a hundred feet. As soon as the shaft is sunk to the required depth a few feet will be excavated in the tunnel, when an iron cylinder with hinged doors will be inserted, so that the laborers can proceed with the work. Compressed air will be forced from the surface into the cavity. Very little blasting will be necessary, the first vein of rock being 1,100 ft. from the New York side, and the rock is soft. The depth of earth over the masonry will not be less in any part than 35 ft., so that no injury can occur from the anchorage of vessels. The cost of this stupendous enterprise will be $15,000,000, of which $10,000,000 has been already subscribed. After several legal contests the Hudson River Tunnel Company has been triumphant, and the president, Colonel Haskin, declares his determination to proceed vigorously with the work.

Julian Hinds to Oversee Santiago Project for White Company

Julian Hinds, engineer at Denver, Colo., of the United States Bureau of Reclamation, has gone to Mexico to take charge of the construction of a large irrigation project near Aguas Calientes. He will be resident engineer on the Santiago project. This project is one of a number being constructed by the J. G. White Engineering Co. for the Mexican government and comprises a dam 350 ft. high and a complete canal and distribution system. Mr. Hinds has been connected with the Denver office of the United States Bureau of Reclamation since 1915. Previously he had designed the distribution system for the Yakima project in Washington, and he is especially known for his work as construction engineer on the Elephant Butte dam in New Mexico. Alfred C. Jaquith, concerning whose association with the White company for work in Mexico was announced in these columns recently, is to be assistant to F. E. Weymouth, chief engineer in the Mexico City office of the White company.

Utah Power & Light Seeks License for Flaming Gorge Project

The Utah Power and Light Co. has applied to the Federal Power Commission for a license in accordance with its preliminary permit of Aug. 15, 1923, covering the company's proposed development at Flaming Gorge on the Green River. Plans call for the construction of a concrete gravity dam 875 ft. long and 270 ft. high, creating a reservoir sixty miles long with an area of 37,200 acres. Equipment sufficient to develop 63,000 hp. will be installed.

Under a resolution adopted by the commission last year no action is to be taken on any application on the Colorado River or its tributaries, pending an agreement among the states of the basin as to allocation of water. Despite the importance of the Flaming Gorge project, which would regulate completely the Green River above the dam, it seems improbable that the commission will make any exception in this case.

New Building for U. S. Patent Office Recommended

The Special Patent Office Committee has reported to Secretary Hoover that the U. S. Patent Office needs a new modern building with up-to-date equipment, and an increased technical force with adequate salaries, if the office is to render proper service to American business. The committee also reports that the patent laws needs to be amended.

Commission Opposes Consolidation of Iowa Engineering Colleges

A special commission appointed by the Iowa State Board of Education, in a report submitted to Governor Hammill recently, to report upon the proposed consolidation of certain courses at Iowa State College, Ames, Iowa, with those at the University of Iowa, states that while a number of consolidations are desirable the consolidation of the engineering schools is not considered advisable. The commission stated that the added expense of maintaining two schools over that of maintaining one was not material and that on the other hand the consolidation would require a considerable new construction. However, the commission recommended a division of some branches of engineering work. It recommended that the chemical, civil and mechanical engineering courses be continued at both institutions, while the courses in sanitary and hydraulic engineering should be emphasized at Iowa State University with agricultural, ceramics and mining engineering stressed at Iowa State College. It also recommended that all short courses in engineering be given at Iowa State College.

Cooper's Tidal Power Scheme Chartered in Canada

A bill to authorize the "Canadian Dexter P. Cooper Company" to generate power from the tides of Passamaquoddy Bay was passed by the Canadian Parliament before it was dissolved recently. The project provides for the development of 500,000 to 700,000 hp. at a cost between $75,000,000 and $100,000,000. A series of dams with navigation facilities is to be constructed between the islands from the coast of Maine to that of New Brunswick, the international boundary here running down the bay which separates Canadian from United States territory. The power house is to be on the American side of the boundary. Recently, Dexter P. Cooper received a preliminary permit for this development from the U. S. Federal Power Commission The Canadian government stipulated in its bill that the work under its control must be subject to the approval of its Water Power Branch and to the International Joint Commission.

Railroad Consolidation Plans In Southwest Advances

In advancement of the plans for the formation of a new railway system in the Southwest, the Kansas City Southern Railway Co., of which L. F. Loree is chairman of the board of directors, has applied to the Interstate Commerce Commission for approval of its projected acquisition of control of the Missouri-Kansas-Texas Railroad Co. through stock ownership. Furthermore, the Missouri-Kansas-Texas Railroad Co. has applied to the commission for similar authority to acquire control of the St. Louis Southwestern Railway Co., thus bringing the control of both railways into the hands of the Kansas City Southern.

The combined mileage of the three railroads in the new system will be 5,801.

Along with these applications the Kansas City Southern has asked for authority to treat the territory south of the Missouri River between St. Louis and Kansas City and from the Mississippi to the Republic of Mexico and the Gulf and westward to New Mexico and Colorado as a separate and distinct territory for transportation purposes.

European Street Railway Meeting

The 20th meeting of the International Association of Street Railways, Light Railways and Bus Transport will be held at Barcelona, Spain, in October. Among the subjects for reports are the following: (1) Local transportation facilities in relation to city development; (2) experimental designs of track to reduce the consumption and cost of oak ties; (3) automatic operation and remote control of switches on lines of heavy traffic; (4) operation of local transportation systems; (5) standardization of electric motors; (6) power distribution and sub-station equipment; (7) rail-motor cars; (8) motor-bus design and service. F. deLancker is president and A. deBacker is secretary of the association.

Paint Survey in Progress by Engineering Foundation

The Committee on Wood Finishing Research of the Engineering Foundation, of which A. H. Sabin of New York City is chairman, has submitted a preliminary report to the Foundation upon the progress of its work. Test fences using sixteen kinds of wood have been erected in different part of the country by the Forest Products Laboratory of the National Forest Service. Each fence includes four panels of each kind of wood painted with a different combination of paint. The test fences have been erected at Madison, Wis., Fargo, N. D., Milwaukee, Wis., Palmerton, Pa., Sayville, N. Y., Washington, D. C., Gainesville, Fla., Grand Junction, Colo., Tucson, Arizona, Fresno, Cal., and Seattle, Wash.

American Welding Society to Hold Fall Meeting at Buffalo

The fall meeting of the American Welding Society will be held in Buffalo on Nov. 17-19. An international welding and cutting exposition will be held in connection with this fall meeting and will open Tuesday afternoon, Nov. 16. The technical sessions include railroad welding apparatus, welding science in the engineering curriculum of universities, and welding in a gaseous atmosphere.

The entertainment includes a trip to Niagara Falls, a view of the Falls from the American side, with an inspection trip through the Niagara Falls power house, a buffet supper on the Canadian side and a special illumination of the Falls. There will be the annual fall banquet, and a meeting of the American Bureau of Welding, the Board of Directors and the Welding Wire Specifications Committee.

B. & M. R.R. Plans Include Much New Construction

The plans for the financial reorganization of the Boston & Maine Railroad Co. proposed by a general re-adjustment committee made up of owners of its securities, has been approved by the Interstate Commerce Commission.

The plan calls for the issue of $13,000,000 of 7 per cent prior-preference stock for certain new construction and betterment of the railroad property, and also the issue of $43,522,000 of mortgage bonds to be used for the refunding of certain outstanding bonds of the company. The railroad company proposes to spend during the next three years for additions and betterments approximately $16,000,000. The items included in the proposed expenditure are an enlarged terminal yard at Boston, additional trackage including double tracking, enlarging the clearances of the Hoosic Tunnel, strengthening bridges and ballasting tracks, constructing a general office building and improving the coal facilities at Mystic Wharf, also the purchase of new equipment including gasoline rail cars.

International Power Development at Grand Falls to Start Soon

Arrangements are being made for a ceremony to mark the beginning of operations on the Grand Falls power development in New Brunswick. According to Premier Baxter the ceremony will take place about the middle of August, following the awarding of the contract for the development work, including the dam, tunnel and power house. This contract, it is understood, will be awarded at the International Paper Company's headquarters in New York.

Meanwhile the contract between the St. Lawrence River Power Co., subsidiary of the International Paper Co., which is carrying on the Grand Falls development, and the Fraser Companies, under which the Frasers get 14,000 primary and 6,000 secondary horsepower from Grand Falls, has been signed.

It has been announced also that the Canadian International Paper Co. will pay the province of New Brunswick $350,000 for the spur line running to the new power house and for the engineering plans and data in connection with the Grand Falls development. The spur line which was commenced last summer when the provincial government started the power development will, it is expected, be completed in the near future.

Cut-Off to Be Cascade Line

According to an announcement of the Southern Pacific Railway Co., the new line which it has been constructing between Weed, Calif., and Eugene, Ore., under the name of the Natron Cut-Off is to be known as the Cascade Line upon its completion. It is expected that the line will be open for operation sometime during the current Summer.

WASHINGTON NOTES

SENTIMENT among the settlers on the government's reclamation projects has changed materially during the past few months, Dr. Elwood Mead, the Commissioner of Reclamation, reports on his return from an extended western trip. "Settlers are confident," he declares. "The irrigation organizations are ready to co-operate with the Department in any constructive program looking to the improvement of conditions.

"Last year," continued Dr. Mead, "it was necessary for Secretary Work and myself to deal mainly with the obligations of the projects and the necessity for meeting these obligations. This year it was not necessary to refer to obligations.

"Last year there had been four moratoriums in payments. They had not relieved the people of their debts, but had increased the amount of the payments that would be required in the immediate future. There was much uncertainty as to whether settlers would be relieved from the payment of charges on land that had proven to be unproductive. The threat of having to pay the water charges on unproductive land has been removed by the passage of the adjustment bill, which also has wiped out debts the water users did not believe they should be called upon to pay. Settlers everywhere were friendly to the Department and are planning for the future."

MAJ. Glenn E. Edgerton, chief engineer of the Federal Power Commission, has returned from a trip to Europe where he visited the Exhibition for International Navigation and Utilization of Hydraulic Power at Basel, Switzerland. The exhibition, Major Edgerton says, calls attention in a striking way to the extent to which the Europeans already utilize the power resources and the navigation possibilities of their rivers and to the comprehensive programs which have been formulated for further development.

The exhibition celebrates the opening of a splendid harbor 550 miles from the mouth of the Rhine which is expected to make Basel one of the great distributing centers in the heart of the Continent.

Major Edgerton reports that positions of particular prominence have been given the exhibits of the Federal Power Commission and of the U. S. Geological Survey.

WHEN the Treasury Department recently ruled that German steel and iron products must pay additional duties in the United States on the ground that export bounties were being paid in Germany, the German Ambassador, under instructions from his government, stated that the Treasury was in error in believing that export bounties were being paid. He asked that before this regulation was finally put into effect, there should be a thorough investigation of the matter by a committee made up of two representatives of the German government and two of the American government. This committee will be a fact-finding body, the Germans to explain thoroughly their system of financing exports in order that the American members of the committee might report the full situation to the Treasury for decision as to whether or not export bounties are actually being paid.

BECAUSE of the important relation of Lake Pend d'Oreille to the Columbia Basin project, the state of Washington will spend the larger part of the state appropriation for the survey of the power possibilities in connection with the use of the lake for storage. The larger part of the federal appropriation will be used in a study of the economic conditions which will control settlement and the development of project lands. An agreement to the foregoing effect was reached at a recent conference between Dr. Elwood Mead, the Commissioner of Reclamations, and representatives of the Columbia Basin League.

THE work of clearing out the Chesapeake and Delaware canal will be begun as soon as the crop movement has been completed. The Atlantic, Gulf and Pacific Dredging Co. will do the work. The $503,000 bid of that company was accepted. The securing of the added depth has been delayed because a large dredge intended for service in the canal sank last year at the mouth of the Delaware, while en route to the project. Because of the high lift and the long pipe line a very powerful dredge is required.

APPLICATION of the Broad River Power Co. for a preliminary permit covering a power project on the Saluda River at Drehers Shoals in South Carolina has been rejected by the Federal Power Commission.

Excavation Wrecks Building

In excavating for the basement and foundations of a new bank at Wheaton, Ill., the adjacent building was badly damaged by a slip of the unsupported stiff clay soil. The entire area was excavated about 2 or 3 ft. below the footing of the stone basement wall of the old building, the projecting edge of the footing stones being then broken off at the property line. A shallow trench was cut for the footing of the new concrete wall. No shoring or underpinning was placed and the footing trench extended the full length of the old wall. As a result the unsupported clay slipped out into the trench, dropping the end of the two-story brick and frame building more than a foot. The stone basement wall dropped almost vertically, but the brick end and front wall above was cracked and distorted, while parts of the brickwork fell and the end wall leaned dangerously over the pit. This building consisted of three bays and the south bay will have to be rebuilt. It did not fall, but wreckers knocked down the brick wall and then shored up the interior.

RANDOM LINES

Why Des Moines Streets Are Crooked

"Mr. Jones who supervised the survey of the future city in the time between April 6 and July 8, 1848, when the plat for the city of Fort Des Moines, population four hundred and something, was recorded.

"*He worked under difficulties. No chain was available for his surveyors, and they used a rope.* On the night before they surveyed Walnut Street west of the river, it rained and the rope shrank and then stretched. This misfortune was perpetuated by the slight jog now a part of Walnut Street, east of West Fifth Street.

"The survey cost $145 all told. Jones received the lion's share, $89.50. William Thorp, a stake driver, was content with 75 cents."—Des Moines *Register.*

* * *

Here's One on Us

Boiler Steel Embittered by Caustic Soda

From the contents page of *Engineering News-Record* for July 22, 1926.

* * *

Dentaliana

Sir—I am very glad to be able to give you some really expert advice in answer to the inquiry of your dental friend, published in this column last week.

South America affords an almost unlimited field for dentists and a situation or site can be found almost anywhere. The natives of the Amazon Valleys have their teeth filled every two weeks. On the River of Doubt there are some choice spots on which to locate and those who move in now can have a monopoly of the business. To dentists who wish to establish relations with the Inca princesses of Alto Planicie, I would suggest the provision of extra wide chairs and gas masks. In Brazil a special knowledge of the nut cracker type of jaw is most desirable as one has to deal with the nuts for which that country is famous.

In the short space available for a letter of this kind it is, of course, impossible to more than indicate the possibilities, but there will be shortly available for your readers my latest work on the subject, covering fully the occurence of dental cavities in the Latin American countries, into any one of which one may fall and find a snap.

Suya hasta la muerte,

LORRITOREAL

* * *

Another, and Up-to-Date, One

According to the "Progressive," of Wheaton, Ill., in reporting the arrest of a moonshine gang:

"The man who in installed the apparatus in the barn for re-distilling moonshine to obtain alcohol is termed by state's attorney Reed a 'moonshine engineer.' He had plans and specifications of a similar plant he had installed at Aurora in his pocket when arrested."

Dominion Government Plans Huge Power Expenditures

The current letter of the Royal Bank of Canada contains a study of the probable future turbine installation cost in Eastern Canada and shows that between 1926 and 1945 about $1,300,000,000 will be required in capital expenditure or that the average expenditure per year for the next 20 years will be close to $65,000,000.

In making this estimate the Dominion Water Power Branch concludes that of this total about $600,000,000 will be required in Ontario and nearly $700,000,000 in Quebec.

Delaware & Hudson to Eliminate Delmar Grade Crossing

The New York Public Service Commission has directed the elimination of the Delaware Turnpike crossing of the Delaware & Hudson Company's tracks in Delmar, an underground highway crossing being ordered as a substitute for the present grade crossing located on the main Albany-Binghamton highway by way of Delmar and the Helderberg Mts. and located a short distance east of the Delmar station.

The grade of the railroad is to be raised 5 ft. The highway underpass will be 40 ft. wide, with a 28-ft. pavement, the latter to be of bituminous macadam, with proper provisions for surface drainage, and concrete sidewalks.

The order of the commission directs the Delaware & Hudson R.R. to prepare plans, specifications, and estimates of cost and submit them to the commission for approval. The railroad is also to build the approaches to the undercrossing.

A traffic check at the crossing has shown a twelve hours average traffic taken from 7 a.m. to 7 p.m. of 2,133 vehicles and 17 trains.

Civil Service Examinations

UNITED STATES

For the following civil service examinations apply to the United States Civil Service Commission, Washington, D. C. or to any local office of the commission.

Chief Architectural Draftsman, Senior Architectural Draftsman, Junior Architectural Draftsman, to fill vacancies in the Departmental Service, Washington, D. C., including the Supervising Architect's Office, Treasury Department, Washington, D. C., and similar positions.

Salary for chief architectural draftsman, $2,400; senior architectural draftsman, $1,860; junior architectural draftsman, $1,680.

Competitors will be rated on a preliminary sketch, final drawings, and education, training, and experience.

Applications for these positions must be on file at Washington, D. C., not later than August 21.

Personal Notes

BEEKMAN C. LITTLE, for many years superintendent of water-works, Rochester, N. Y., and for the past two years or so part-time secretary of the American Water Works Association, has resigned his Rochester position to become full-time secretary of the association. Mr. Little's business address will be 170 Broadway, New York City, but he will maintain his Rochester residence.

FREDERICK S. BACON, formerly president of the Puritan Dye & Chemical Co., has joined the organization of Arthur D. Little, Inc., chemists, engineers and managers, of Cambridge, Mass.

GEO. M. BULL, Denver, Colo., has been appointed consulting engineer for the Denver Municipal Water Works Board.

C. H. OWENS, Meridian, Miss., has been appointed division engineer of the Mobile & Ohio R. R., vice J. M. Southgate, J. L. Cummings and J. J. Gallagher.

A. C. D. BLANCHARD is now resident engineer on the construction of the power equipment for the St. John River Power Co. at Grand Falls, New Brunswick, having severed his connection with the New Brunswick Electric Power Commission for which he had served as a hydraulic engineer since 1924. Prior to 1924 he was for several years engaged as chief field engineer in charge of surveys, field engineering and inspection on the Queenston-Chippewa power development.

JAKE M. BOYD of the firm of Butler, Barnett & Taylor, was appointed county engineer of Palm Beach County, Florida, succeeding Roy Goodman, who two months before succeeded Alex O. Taylor of the above firm. Mr. Boyd was formerly employed by the firm of Butler, Barnett & Taylor, in charge of all field projects.

W. C. HOWE, formerly employed by the Southern Power Co. of Charlotte, N. C., is now engaged in construction work for the Tallassee Power Co., of Calderwood, Pa., on power house and penstocks at Tapoco, N. C.

M. A. FOUCHY, consulting engineer, has opened an office at 45 West 45th St., New York City, for work on estimates, design and supervision of building construction, especially tall building frames, industrial plants, power houses and factories.

GEORGE L. CLARK, Jefferson City, Mo., has been promoted from the position of division construction engineer to that of assistant state maintenance engineer with the Missouri State Highway Department.

E. L. HEIDENREICH, Kansas City, Mo., of the engineering company which bears his name, has been made a knight of the Royal Norwegian order of St. Olav, by the king of Norway. This honor was conferred in recognition of Mr. Heidenreich's engineering achievements, especially his work on fireproof circular monolithic cluster tanks of reinforced concrete for storage of grain, cement, sand, crushed stone and other materials.

CLARENCE L. ECKEL, professor of civil engineering at the University of Colorado, has been appointed head of the civil engineering department, to succeed Whitney C. Huntington.

DR. HOWARD BARNES, of McGill University, Montreal, has left for Newfoundland, where he will study ice formations and conduct experiments on the effect of thermite on icebergs.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Meeting, Providence, R. I., Sept. 14-17, 1926.

INTERNATIONAL CITY MANAGERS' ASSOCIATION, Lawrence, Kansas; Annual Convention, Colorado Springs, Colo., Sept. 21-23, 1926.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; Annual Convention, Philadelphia, Pa., October 4-9, 1926.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York City; Annual Meeting, Buffalo, N. Y., Oct. 11-14, 1926.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Convention, Pinehurst, N. C., Nov. 8-12, 1926.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.; Annual Meeting, Washington, D. C., Nov. 8-12, 1926.

THE ASPHALT ASSOCIATION, New York City; Annual Meeting, Washington, D. C., Nov. 8-12, 1926.

Obituary

ASHBEL E. OLMSTED, retired civil engineer and railroad builder, died Aug. 15 at his home in East Hartford, Conn., aged 80 years. Mr. Olmsted began railroad construction in 1870 on the Connecticut Valley R. R. and later was engaged on railroad construction in New York, Pennsylvania, and other states in the East and on the Pacific Coast. Subsequently he was a division engineer in construction of parts of the New York City subways. He retired in 1918 from active construction work.

Construction Equipment and Materials

A SECTION DEVOTED TO WHAT THE MANUFACTURER IS DOING FOR THE ENGINEER AND CONTRACTOR

Concrete Road Yardage

For July the square yardage included in concrete pavement contract awards, according to the Portland Cement Association, were: 5,662,841 for roads; 4,865,421 for streets; and 327,313 for alleys; or a total for the month of 10,855,575 sq.yd.

The accompanying table summarizes the statistics for the current year:

SQUARE YARDS OF CONCRETE PAVEMENT AWARDED DURING 1926

Month	Roads	Streets	Alleys	Total All Classes
Jan.	2,161,415	1,410,201	57,218	3,628,834
Feb.	2,726,611	2,010,941	274,836	5,012,388
March	4,662,885	3,050,630	224,879	7,938,394
April	8,758,195	4,324,729	479,763	13,562,687
May	8,910,678	4,619,195	507,250	14,037,123
June	10,793,452	5,999,859	524,572	17,317,883
July	5,662,841	4,865,421	327,313	10,855,575
Totals	43,676,077	26,280,976	2,395,831	72,352,884

Business Notes

WORTHINGTON PUMP & MACHINERY CORP., New York City, has just elected L. J. Belnap as president. C. Philip Coleman, retiring president, was elected chairman of the board. Mr. Belnap was formerly president of Rolls Royce Co. of America and chairman of Wills St. Claire Co., Detroit.

THE PRESTON F. SAYRE CO., announces the incorporation of the Sayre Steel Construction Co., Inc., 50 Church St., New York City. Officers are Preston F. Sayre, president, Walter F. Barker, vice-president, and Edward M. Bell, secretary.

INLAND ENGINEERING CO., Chicago, announces that effective July 29 the name of the company was changed to Kensington Steel Co. The address and management remain as heretofore. The change was made in order that the name might be more descriptive of the company's activities.

W. N. MATTHEWS CORP., St. Louis, manufacturers of mechancial painting equipment, announce that George M. Gerew, formerly assistant sales manager, Binks Painting Equipment Co., has been made new district manager. A service department is also maintained in connection with the sales force.

INDUSTRIAL PLANTS CORP., New York City, has recently announced the sale of land, buildings and equipment of the Mid-Continent Iron Co. at Midco, Carter County, Mo. This plant was taken over by the government during the war and operated under the supervision of the Bureau of Aircraft. About $3,000,000 was invested in the plant, which was abandoned after the war, following which the population of the town depleted until now only a few families are left. There are 25 cottages and 300 workmen's homes for sale, in addition to the equipment. The corporation has a representative manager on the ground.

BROWN HOISTING MACHINERY CO., Cleveland, announces that H. G. Steinbrenner has been elected second vice-president of the company and will have charge of marketing the company's products.

MASSEY CONCRETE PRODUCTS CORP., Chicago, announces that its San Francisco office has been consolidated with its Los Angeles office to be located in the Pacific Electric Building, Los Angeles, Calif. F. V Shannon, western manager, will be located at the Los Angeles office.

HARRY S. BEALE, for the last 12 years on the sales force of the Blaw-Knox Co. and the Osgood Co. respectively, has accepted a similar position with the Harnischfeger Sales Corp., Milwaukee, Wis.

PENNSYLVANIA PUMP AND COMPRESSOR CO., Easton, Pa., has appointed Samuel Arnold as its representative in the Pittsburgh district.

New Developments

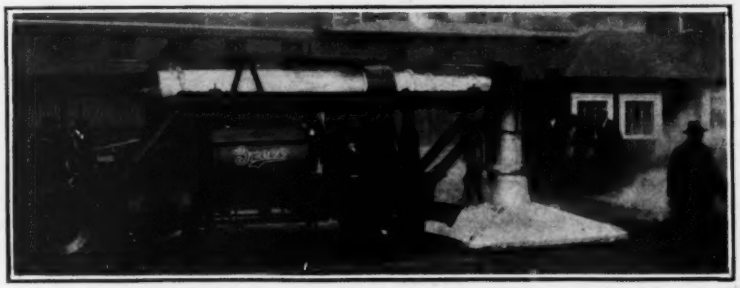
Tractor Mounted Asphalt Heaters Made in Smaller Sizes

Previously large portable asphalt heaters have been leased on a yardage basis and were used by only the larger cities in the United States. The "Greco" pavement superheater has recently been placed on the market by the Good Roads Equipment Corp., Philadelphia, in sizes suitable for small cities and counties. The heater is built around a Fordson tractor using a readily detachable frame of steel channels. It consists essentially of an oil burner, blower, sectional steel furnace and a heating hood. No flame comes in contact with the pavement, hot air providing the heat.

Regulation Fordson wheels are used on the rear of the tractor, while metal wheels are used at the front near the hot end. The furnace is of all metal construction, consisting of an inner or combustion tube enclosed in an outer tube. The inner tube is made in sections in order to facilitate replacements, and to reduce the cost of repairs. The burner end is closed by a hinged door. The air enters between the inner and outer tubes, at the end farthest from the burner, and passes between the two tubes until it reaches the burner end of the combustion chamber. Thence it goes through the combustion chamber and an elbow which turns the blast toward the road and into the hood. The blower is made by the B. F. Sturtevant Co. The burner is of the mechanical atomization type using oil for fuel. The oil flame is visible at all times, through a wired glass window. Oil pressure is developed by a rotary pump and automatically maintained at a predetermined figure by a pressure regulator. A fuel tank of 250 gallons capacity is carried on the heater. An auxiliary pump is attached to facilitate the transfer of oil from a tank wagon or other source of supply to the fuel tank. Both the pumps and the blower are driven by means of belts from a shaft connecting to the crankshaft of the engine by menas of flexible couplings. The hood is 8x8 ft., counterbalanced by springs and is raised and lowered by a handwheel. The over-all length of the machine is 27 ft. and its weight something under 8 tons.

Colloidal Admixture for Concrete

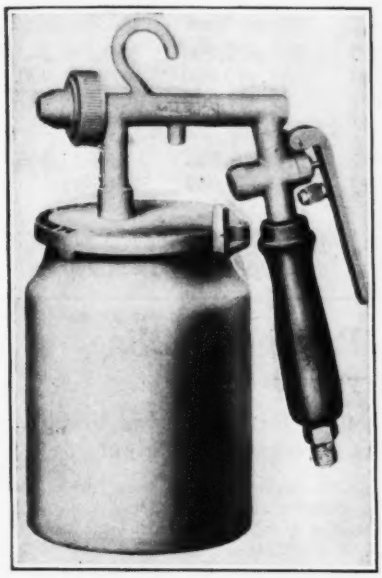
Furnished as a dry yellow powder in bags and when wet in the normal mixing of concrete, changing into a jelly-like or colloidal state, a new admixture called Colloy, made by Colloy Production Co., 4030 Chouteau Ave., St. Louis, is claimed to have a number of advantages. It is said to be practically inert chemically, containing principally silica, alumina and a small percentage of the alkaline earths such as lime and magnesia. It is of very small grain size, and practically insoluble in water. When more than sufficient water for the hydration of the cement is used, the addition of this Colloy is claimed to dry down the mix because of its water absorption qualities. It is said to take up about ten times its own volume of water, and still retain a semi-solid collodial form. Workability of the concrete, and the characteristic of holding the concrete mass together are other claimed advantages, in addition to watertightness,



improved appearance and finish, dry consistency, less segregation in transportation, reduction of variation in the concrete, and greater uniformity. About two pounds of Colloy per bag of cement is added dry.

New Paint Spray of Self-Contained Type

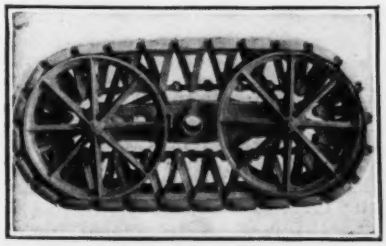
The illustration shows the new paint spray manufactured by the Alexander Milburn Co., Baltimore, Md. The atomization is regulated by a turn of the nozzle, from a small to a large spray. A pressure of 40 lb. is usually used, but this can be varied to suit the



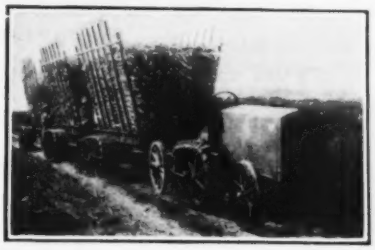
work. Carbonic gas tanks are also employed with good results. It is claimed that air pockets and daubing are eliminated entirely by this apparatus. There are no small parts to get out of order, the entire equipment consisting of a cover, body, atomizer, and a convenient handle.

Crawler Tread Designed as a Truss

A crawler tread that has found wide application in the cane fields of Cuba and the logging camps of South America is manufactured by the Athey Truss



Wheel Co., 130 North Wells St., Chicago, and is being marketed for export service by the Baldwin Locomotive Works. It finds special adaptation in the wet sugar-cane fields where ordinary wheels are of practically no use. The construction is simple, yet extremely sturdy. The wheels, which operate on Timken roller bearings, are mounted in pairs to prevent any possibility of the track coming off. No intermediate track rollers, whose bear-



THREE 5-TON SUGAR CANE CARTS EQUIPPED WITH CRAWLER TREADS

ings would have to operate in the mud, are used. Instead, the load is carried by the track itself, which forms a rigid truss bridge from wheel to wheel, rather than assuming the contour of the road. The wheels are joined together by a box section rocker beam, in the center of which is the hub for the wagon axle.

As noted in the illustration, triangular trusses form a part of each shoe and are connected by heavy forged links. Since the shoe will open only inward, the system forms a rigid bridge from track wheel to track wheel. Each truss shoe is a complete unit. The chain links are of chrome nickel steel held together by large rivets. Bolts carry the links in the truss shoes. The shoes lie extended in front and rear as the track wheels roll over them, so the pins do not rotate when loaded.

Boom Type Backfiller As a Fordson Attachment

A light, boom type backfiller has recently been developed by the Baker

Steel & Machinery Co., Omaha, Neb., for attachment to the Fordson tractor. It is equipped with a double drum hoist and operated by one man from the driver's seat. The operating levers are located one on each side of the steering wheel.

The boom is adjustable for length from 12 to 26 ft., by telescoping, and can be instantly adjusted for vertical and horizontal angle. The steel bucket may be quickly set to suit varying soil conditions. The outfit is furnished complete, including double drum winch, power-take-off, head-frame, boom, bucket, cables and operating levers. It does not interfere with the use of the tractor for other purposes.

In moving, the boom is collapsed and hung in a rack beside the head-frame. The original application of the backfiller on the tractor requires about one hour; holes already in the tractor are used for connections. The backfiller attachment weighs 1,275 lb. complete. The backfiller when used as a crane exerts a direct pull of 3,500 lb. with the in-hall cable.

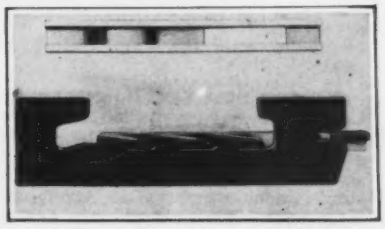
A New Design Rail Anchor

A new rail anchor known as the "Bethco" recently placed on the market by the Bethlehem Steel Co., Bethlehem, Pa., claims as its outstanding features a sufficient adjustment to fit rails in any condition, and an original design

which prevents the two parts of the anchor from being separated.

Although the anchor is of two piece construction it is shipped and installed as one piece. The two pieces can only be separated with considerable difficulty and by a very unusual manipulation of the parts. This two piece construction allows sufficient adjustment to take care of more than one rail section and also the tendency of rails to wear thin because of friction on the tie plates or because of corrosion.

The anchor consists of a flat yoke which hooks over the base of the rail on both ends, and a key which is driven horizontally between the base of the rail and the yoke. The wedging action of the key is crosswise of the rail, along practically the entire base of the rail. This fact and



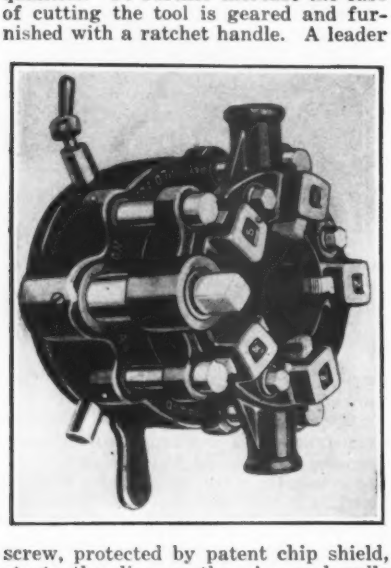
NEW RAIL ANCHOR DESIGN

the channel shape of the key prevents it from being forced sidewise off the yoke.

The surface of the yoke bears against the surface of the tie for its entire length. The anchor meets all the specifications of the A.R.E.A. requirements for rail anchors and anti-creepers. The company is being assisted in the introduction of the device by George L. Moore, former engineer of maintenance of the Lehigh Valley railroad, and chairman of the 1925 A.R.E.A. rail committee.

Easy Cutting Die Stock for 2½ to 4-In. Pipe

By means of narrow dies that are ground with an extra long lead and sharp rake, the Oster Mfg. Co., Cleveland, has designed a die stock that is claimed to have special easy cutting qualities. To further increase the ease of cutting the tool is geared and furnished with a ratchet handle. A leader



screw, protected by patent chip shield, starts the dies on the pipe and pulls them along, producing the proper pitch and taper. A rotary movement of the die head adjusts the dies to cut either deep or shallow threads.

A lever-operated, self-centering chuck insures a straight thread on all pipe sizes from 2½ to 4 in. The threading of short nipples is also possible.

New Publications

Metal Lath and Mesh—CONSOLIDATED EXPANDED METAL CO., Braddock, Pa., has recently issued a condensed catalog of its products giving specifications and illustrating its metal laths of several different designs, corner beads, channels, wall ties, and reinforcing mesh.

Hoists — SULLIVAN MACHINERY CO., Chicago, in its new booklet No. 132, entitled "Handy Hoisting and Hauling," shows a variety of applications for its small portable hoists, of both the turbinair and electric types. About sixty or seventy different applications of the hoists are illustrated.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, religious and other buildings.

Money Value of Contracts Let—Entire U. S.

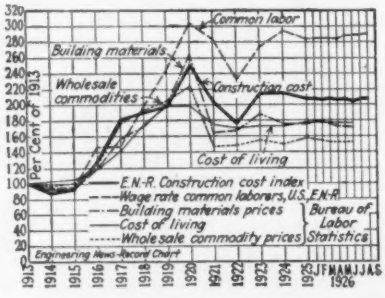
Week Ending	Public Work	Private Work	Total Contracts
Aug. 19, 1926	$34,682,000	$34,671,000	$69,353,000
Aug. 12, 1926	22,002,000	38,919,000	60,921,000
Aug. 20, 1925	28,549,000	27,981,000	56,530,000
Heaviest Week			
1926, Mar. 11	13,029,000	73,613,000	86,642,000
1925, Sept. 3	16,215,000	69,424,000	85,639,000
January 1 to date			
1926	724,090,000	1,136,299,000	1,860,389,000
1925	675,677,000	856,253,000	1,531,930,000

Building Materials Prices on Decline Since February This Year

More Than Slight Recessions Not To Be Expected in Group Where Orders Form Large Percentage of Output

THE fact that volume of orders for basic construction materials is so near to that of production, and in some cases greater, does not argue for an indefinite continuation of the very gradual downward trend in building materials' prices, evident since February of this year.

Wholesale prices of all commodities taken together, declined steadily during the first four months of 1926. Since then, however, the tendency has been upward. This later movement in wholesale commodity prices has not yet affected the cost of living figure.


Per Cent of 1913
Common labor
Building materials
Wholesale commodities
Construction cost
Cost of living
E.N.-R. Construction cost index
Wage rate common laborers, U.S., E.N.-R.
Building materials prices
Cost of living
Wholesale commodity prices
Bureau of Labor Statistics
Engineering News-Record Chart
1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926
J F M A M J J A S

One reason why abrupt declines are not to be expected in construction materials, is that in this group, more often than in any other, the order is filled after the sale has been made and no excessive reserve stocks are retained at either the manufacturing plant or the warehouse.

The slightly higher level of current construction cost, than that prevailing at the outset of the year, may be attributed almost entirely to higher wages of construction labor.

Examination of latest reports on production and demand in four of the chief building materials, shows that cement, lumber and brick orders are in excess of output while unfilled steel tonnage is but slightly below ingot production.

Cement demand, as reflected in shipments for the month ending July 31, amounted to 18,767,000 bbl., against an output of 17,121,000 bbl. during the same period. In this case demand is 109 per cent of production. Following are latest cement statistics for the U. S., according to the Bureau of Mines:

	Production Barrels	Shipments Barrels	Stocks* Barrels
July, 1926	17,121,000	18,767,000	17,254,000
June, 1926	16,827,000	19,113,000	18,900,000
July, 1925	15,641,000	18,131,000	13,896,000

* At mills on last day of each month.

Lumber orders are about 101 per cent of actual production, in the principal softwood mills of the country, according to the National Lumber Manufacturers' Association. This is particularly true of Southern pine mills. The following tabulation compares the national softwood lumber movement for the three weeks indicated:

	Week of Aug. 7 Ft. b.m.	Corresponding Week in 1925 Ft. b.m.	Preceding Week in 1926 Ft. b.m.
Production	238,581,468	235,287,744	228,844,913
Shipments	232,307,880	259,600,482	237,132,553
Orders	241,826,980	255,453,296	229,478,991

(*Continued on p. 321*)

Per Capita Road Lettings And Motor Registrations Shown By States

RECORD motor vehicle registrations for the year 1925, though met by a record volume of street and road contract letting for the nation as a whole, still leave a question as to the effect of this increasingly large volume of motor traffic upon the fourteen states that report comparatively small per capita road awards.

The fourteen states referred to are: Arizona, Arkansas, Delaware, Georgia, Kentucky, Maine, Massachusetts, Montana, New Jersey, New Mexico, South Carolina, Utah, Vermont, and Virginia.

Six of these, namely, Arizona, Maine, Montana, New Mexico, Utah and Vermont, are of fairly large area but small population.

DERIVATIONS OF PER CAPITA FIGURES ON MOTOR REGISTRATIONS AND ROAD LETTINGS

State	Population	Value of Street and Road Contracts	Per Capita Street and Road Lettings	Motor Registrations	Per Capita Motor Registrations
Alabama	2,453,214	$7,996,000	$3.26	194,580	0.07
Arizona	399,066	656,000	1.64	68,029	0.17
Arkansas	1,841,081	3,491,000	1.89	183,589	0.09
California	3,951,517	32,983,000	8.34	1,440,541	0.36
Colorado	1,009,931	2,050,000	2.02	240,097	0.23
Connecticut	1,513,568	3,265,000	2.15	250,669	0.16
Delaware	233,343	*	†	40,140	0.17
Florida	1,076,395	10,425,000	9.68	286,388	0.26
Georgia	3,039,187	1,606,000	.52	248,093	0.08
Idaho	485,002	1,005,000	2.07	81,506	0.16
Illinois	6,908,624	25,935,000	3.75	1,263,177	0.18
Indiana	3,045,147	6,267,000	2.05	725,410	0.23
Iowa	2,493,646	6,286,000	2.52	659,202	0.26
Kansas	1,808,411	5,467,000	3.02	457,033	0.25
Kentucky	2,479,992	3,125,000	1.26	261,647	0.10
Louisiana	1,869,569	15,458,000	2.91	207,000	0.11
Maine	780,835	1,350,000	1.72	140,499	0.18
Maryland (incl. D.C.)	2,017,640	6,431,000	3.18	337,339	0.16
Massachusetts	4,095,326	7,244,000	1.76	646,153	0.15
Michigan	4,097,531	15,742,000	3.84	989,010	0.24
Minnesota	2,542,833	8,971,000	3.52	569,694	0.22
Mississippi	1,797,114	6,376,000	3.54	177,262	0.09
Missouri	3,459,415	20,590,000	6.06	604,166	0.17
Montana	635,307	298,000	.46	94,656	0.15
Nebraska	1,348,451	6,683,000	4.95	338,719	0.25
Nevada	81,875	1,177,000	14.37	21,169	0.25
New Hampshire	449,338	993,000	2.20	81,498	0.18
New Jersey	3,465,266	6,663,000	1.92	580,554	0.16
New Mexico	376,874	625,000	1.65	49,111	0.13
New York	11,021,033	25,569,000	2.32	1,625,583	0.14
North Carolina	2,735,541	19,505,000	7.13	340,287	0.12
North Dakota	681,780	1,563,000	2.29	144,972	0.21
Ohio	6,255,530	35,709,000	5.70	1,346,400	0.21
Oklahoma	2,213,847	11,626,000	5.25	424,345	0.19
Oregon	838,701	4,589,000	5.47	216,553	0.25
Pennsylvania	9,247,470	56,634,000	6.12	1,330,433	0.14
Rhode Island	635,290	2,200,000	3.46	101,756	0.16
South Carolina	1,767,886	2,422,000	1.37	168,496	0.09
South Dakota	662,876	2,413,000	3.64	168,028	0.25
Tennessee	2,414,433	7,934,000	3.28	244,626	0.10
Texas	5,046,571	23,153,000	4.58	975,083	0.19
Utah	487,418	*	†	90,500	0.18
Vermont	355,956	467,000	1.31	69,576	0.19
Virginia	2,432,974	431,000	.18	282,650	0.11
Washington	1,463,936	9,154,000	6.25	328,442	0.22
West Virginia	1,584,992	9,077,000	5.72	217,589	0.13
Wisconsin	2,781,170	8,416,000	3.02	594,386	0.21
Wyoming	218,620	1,019,000	4.66	47,711	0.21

* All jobs were under $25,000. † Considerably under $0.18.

Three others, Arkansas, Georgia, and South Carolina, are of fairly large area and heavily populated but had small per capita motor registrations in 1925.

Delaware is conspicuously small in population as well as size; this state and Utah, however, were the two lowest in per capita road lettings for 1925. Delaware ranks about twenty-fifth in per capita motor registrations, or in a class with Arizona and Missouri.

This leaves Kentucky, Massachusetts, New Jersey and Virginia in a conspicuous position as far as possibilities for future road building are concerned, because of sufficient area, large population, fairly heavy per capita motor registrations, yet comparatively small per capita street and road lettings.

The other thirty-four states show sufficiently heavy per capita road lettings to take care of the traffic density as indicated by per capita motor registrations for the year 1925.

In per capita motor registrations the six highest were: California, Florida, Iowa, Kansas, Nebraska and Nevada; the six lowest, Tennessee, South Carolina, Mississippi, Arkansas, Georgia, and Alabama.

In per capita road lettings the six highest were: Nevada, Florida, California, North Carolina, Pennsylvania, and Missouri; the six lowest, Kentucky, Georgia, Montana, Virginia, Utah, and Delaware.

The street and road contract totals are from the Construction News section of *Engineering News-Record* and cover awards of $25,000 and over. The motor registration figures are from the Bureau of Public Roads.

Population figures for each state are those of the 1920 census, to which have been added an estimated five-year total, in each case, based on the gains recorded for the period 1910 to 1920.

Building Materials Prices on Decline

(*Continued from p. 320*)

Brick orders are approximately 114 per cent of the amount of burned brick on hand at yards throughout the country. Following statistics are from the Common Brick Manufacturers' Association of America:

	Burned Brick On Hand	Brick Moved From Yards During Month	Orders On Books
July 1, 1926	193,246,000	149,170,000	220,078 000
June 1, 1926	250,849,000	192,065,000	265,435,000
July 1, 1925	225,401,000	173,215,000	326,226,000

Steel orders on books of the U. S. Steel Corporation July 31, 1926, totaled 3,602,522 tons. The steel ingot output for all companies as calculated by the American Iron and Steel Institute, was 3,651,055 tons for the month of July, 1926. This would make the unfilled tonnage almost 99 per cent of the steel ingot production for the same period. Following are the Institute's figures on output compared with the Steel Corporation's report on unfilled tonnage:

	Ingot Production Tons	Unfilled Orders* Tons
July, 1926	3,651,055	3,602,522
June, 1926	3,750,653	3,478,642
July, 1925	3,084,472	3,539,467

* On books, last day of each month.

Barge Freight Costs on N. Y. State Canal Higher than by Rail

The total cost of freight transportation on the New York State Barge Canal is more than twice that by rail in the same territory, according to a study recently completed by the Bureau of Railway Economics.

"The State of New York," according to the study, "has built and owns the New York State Barge Canal, having issued special bonds to meet the cost of construction. The State also maintains the canal, which is open to the public as a transportation agency, free of toll. In other words, the people of the State of New York have taxed themselves and are continuing to tax themselves to build and maintain a free waterway. The only cost incurred by a shipper of freight on the canal is the charge he pays to the operator of the barge which carries his freight, together with storage and terminal charges and insurance, and the barge operator's charge is low because he is under no expense for the use or maintenance of the waterway, and his only capital investment is in his boat. Because it is government property, no taxes are assessed on the canal or its terminals and warehouses, which fact further reduces the cost of transportation by canal.

"In figuring the total cost of transportation via the canal, however, not only the boat operator's charges must be included, but also the cost of carrying the capital invested by the State in the canal, as well as the annual cost of maintenance, repair and depreciation."

To transport a ton of freight one mile by the canal cost 2.533 cents in 1925, according to the Bureau of Railway Economics, while the total cost by rail was 1.108 cents. Since 1922, the comparative costs for carrying a ton of freight one mile have been as follows:

	By Canal, Cents	By Rail, Cents
1922	3.648	1.172
1923	3.481	1.104
1924	3.260	1.122
1925	2.533	1.108

"Despite the considerable reduction in canal costs in 1925, due in part to reduced maintenance expenditures and in part to the increase in traffic, the total cost of transportation by the Barge Canal in 1925 was more than twice that by rail in the same territory."

Further increase in canal traffic and reduction of maintenance costs, to any very great extent, are not anticipated by New York State officials, it is claimed by the Bureau.

Weekly Construction Market

PRICES are fairly steady with few changes of importance noted during the last week.

The lumber market reports, without exception, reflect either improvement in conditions or firmer prices. For some time past, price reductions have been confined to one- and two-inch material. Going back to the basic materials, which after all exert a controlling influence on finished products, it is found that pig-iron demand is at present confined to small-lot buying with prices firm, particularly on No. 2 foundry, Southern, at Birmingham; in the Eastern states basic pig iron is active. Scrap continues to advance.

The principal hot-rolled steel products are quoted at a minimum of $1.90 per 100 lb., Pittsburgh mill, for large tonnages; a maximum of $2.10 applies on small lots of shapes and bars. Plates are moving in smaller volume with the price at 1.90 per 100 lb. flat, f.o.b. mill.

The effect of foreign competition on current steel prices is best expressed by David H. Smith & Sons, Inc., of Brooklyn, N. Y., dealers in iron, steel and hardware, who state that "a Newark warehouse with a fairly large stock of foreign bars has recently been quoting prices from $2 to $5 less a ton than those quoted by other warehouses, both on reinforcing and merchant steel bars. The influx of foreign steel in the New York district is beginning to be felt acutely by the large steel mills as well as other warehouses and ourselves, due to the low prices they (the importers) are able to quote." The firm in question finds, however, that July bookings for bars, beams, channels, angles, etc., ran ahead of June business and that thus far, August purchases have been keeping up to the July rate.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb	$3.34	$3.80	$4.15	$3.10	$3.35	$3.07½	$3.30	3.35	$4.00
Structural rivets, 100 lb	4.20	5.00	4.75	3.50	3.75	4.65	5.00	4.00	5.50
Reinforcing bars, ¾ in. up, 100 lb	3.24	—2.80	3.38	2.60	2.87½	3.77½	2.95	3.25	2.50
Steel pipe, black, 2½ to 6 in. lap, discount	48%	54%	53.6%	51%	54.25%	36%	35.6@49.2%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	51.60@53.60	—45.25	54.00	49.20@50.20	53.00	64.00	50.00	55.00	55.00
Concreting Material									
Cement without bags, bbl	2.50@2.60	2.35	2.05	2.10	2.32	2.85	2.31	2.65	1.15
Gravel, ¾ in., cu.yd	1.75	1.90	2.38	1.60	1.65	1.90	1.80	1.50	1.50
Sand, cu.yd	1.00	1.60	2.00	1.40	1.25	1.00	1.40	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.85	2.50	2.83	1.87½	1.75	2.50	1.70	3.00	2.00
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	62.00	34.00	56.00	40.50	38.25@38.50	34.75	27.00	23.00	—50.00
Lime, finishing, hydrated, ton	18.20	23.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.10@3.00	1.50	1.85	2.25	1.60@1.70	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	20.40@22.40	10.50	14.10	12.00	13.75	9@10	15.00	15.00	20.50
Hollow building tile, 4x12x12, per block	Not used	.0895	.112	.075	.076	.075	.....	.09	.10
Hollow partition tile 4x12x12, per block	.1112	.0895	.112	.075	.076	.075	.108	09	.08
Linseed oil, raw, 5 bbl. lots, gal	+ 95¼	— 99¾	1.13	—.91	1.03½	—1.14	1.00	1.12	1.03
Common Labor									
Common labor, union, hour	.90⅝	.30	....	.87½	.....	50@.55	55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.82½	.45@.60	40@.45	50	.50	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent. L.c.l. is less than carload lots.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Reinforcing bars (billet steel) and shapes delivered to job in less-than-carload lots.

Labor — Cement and concrete laborers' rate, $1.06¼; building laborers, 90⅝c.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone f.o.b.; price on fir is quoted instead of pine. Reinforcing bars (billet steel) f.o.b. warehouse in carload lots; shapes, less-than-carload lots.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. Bars (billet steel) at warehouse in carload lots; shapes, less-than-carload lots.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Aug. 5 the next on Sept. 2.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net. Bars (billet steel) and shapes, l.c.l.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Dallas quotes lime per 180-lb. bbl. Cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. Bars (billet steel) and shapes, l.c.l.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C.-I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers. Bars (billet steel) and shapes, less-than-carload lots.

Montreal quotes on fir lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 100.177). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½ in., $37.83. Bars (billet steel) and shapes, less-than-carload lots.

Business Briefs

Call money quoted at 4½ per cent, Aug. 17; year ago 4 per cent.

Time loans: Sixty-ninety days, 4¾; four-six months, 4¾@5 per cent.

Commercial paper: Best names 4¼ per cent; other names, 4½ per cent.

On Aug. 1, 1926

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For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month